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Exhibit 17

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IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF NEW YORK

H. CRISTINA CHEN-OSTER; SHANNA ORLICH; ALLISON GAMBA; and MARY DE LUIS,	Case No. 10-cv-6950 (AT) (RWL)
Plaintiffs,	**CONFIDENTIAL**
v.	
GOLDMAN, SACHS & CO. and THE GOLDMAN SACHS GROUP, INC.,	
Defendants.	

EXPERT REPORT OF KATHRYN SHAW, PH.D.

March 19, 2021

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1. INTRODUCTION

1.1. Qualifications

1. My name is Kathryn Shaw and I am the Ernst C. Arbuckle Professor of Economics at the Stanford Graduate School of Business, and BP Faculty Fellow in Global Management. I received my Ph.D. in Economics from Harvard University and my A.B. from Occidental College, Los Angeles. I received an Honorary Doctorate from the University of Maastricht.

2. I head the Personnel Economics group of the National Bureau of Economics Research. I am also currently Research Associate, National Bureau of Economic Research (NBER), Research Fellow, SIEPR, and Research Fellow, IZA, Germany. This past year, I was co-leader of the international seminar series during Covid, the CEPR International Virtual Organization Economics Seminars (CIVOE-Seminars).

3. Most recently, I have been a Visiting Professor, University of Maastricht, winter 2020; Brookings Institute Visiting Scholar, winter 2020; Visiting Professor, University College London, spring 2019; Visiting Professor, MIT Sloan, fall 2018; and Visiting Professor, IZA, Germany, fall 2018 and Visiting Professor, IZA, May 2014. I have been the honorary economics lecturer, Boston University, winter 2021, Distinguished Lecturer, and the honorary Joe Tiao Lecturer, Kansas State University, 2019.

4. I was a Senate-confirmed Member of the Council of Economic Advisors, President Clinton, Executive Office of the President, 1999 to 2001. I helped formulate the government's economic policy, including briefing the President on issues relating to technical change and growth, labor and unemployment, microeconomic policies, including health, fiscal policy, the environment, and macroeconomic and fiscal policy. I have testified before Congress on a number of occasions.

5. I am currently the incoming Vice President and then President for the Society of Labor Economists, for 2021–2024. I have been an editor of the *American Economic Review*, *Journal of Political Economy*, the *Review of Economics and Statistics*, *Journal of Labor Economics*, and *Journal of Economic Perspectives*, and on the Editorial Advisory Board of the *Journal of Economic Perspectives*. I am currently a board member of the Society of Labor Economists, and in 2008

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I was elected a Fellow of the Society of Labor Economists. I have served on a Research Panel of the National Science Foundation and am currently a board member of the STEP panel of the National Academy of Sciences. I have given keynote lectures, including those at meetings of the Society of Labor Economics and the European Labour Economics Association.

6. I give from 12 to 15 seminars per year at research universities or conferences.

7. I have researched and taught labor economics, personnel economics, econometrics, contemporary economic policy and macroeconomics for over 40 years, for MBA students and PhD students. Labor economics is a very broad field within economics, covering all manner of issues relevant to the labor market for people or for workers, thus covering labor supply to labor demand to wages. Personnel economics is a field that resides within labor economics, and is the study of how firms manage their employees, including compensation methods, hiring, promotion, performance management, training, and the overall strategy firms must develop to take a long run view to running their firm. I have received several teaching awards, including the Trust Faculty Fellow for 2005–06 and 2011–12, and the Xerox Research Chair.

8. I currently teach and research topics in Artificial Intelligence, including a new course on "The Productivity Effects of AI" for the Stanford MBA students. I give lectures on "Management in the Age of AI."

9. Regarding my research, I co-pioneered the field of "insider econometrics," a research field in personnel economics in which researchers go within companies and use insider knowledge and data to identify the performance gains from management practices. I am widely published on the topic of personnel economics and labor economics. These, and related publications, have been published in the top three journals in the economics profession: the *American Economic Review*, the *Journal of Political Economy*, and the *Quarterly Journal of Economics*. I am the author of over sixty publications in journals and books. My publications have focused on a wide range of personnel economics topics, topics which would be called people management strategy or human resource management. These topics include compensation and evaluation, promotions, decision rights for employees, and the impact of managers on raising the productivity of their employees. Additional specific topics include the dispersion of talent between firms and the variance of compensation within firms, the impact of information technology on

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productivity in firms, and the productivity impact of non-compensation practices, such as the use of work teams, and careful screening of workers. For all of these topics, I write about why companies use these particular human resource management practices. In 2001, I received the Columbia University award for the best paper on international business, and in 1998, I was honored as the recipient of the Minnesota Award for Employment Research for the best paper in 1997–98 on the topic of employment issues.

10. Throughout the course of my work on personnel economics (and insider econometrics), I have studied and visited approximately 95 firms in the U.S., Europe, and Japan. Firms I have visited have been involved in diverse industries such as finance, software, steel, chemicals, electricity generation, retail trade, services, bio-technology, pharmaceuticals, and the trucking sector. The purpose of these visits was to study the effects of personnel management practices on workers' productivity. From 2003 to 2009, I (along with Richard Freeman) headed the National Bureau of Economic Research project on "International Differences in the Business Practices and Productivity of Multinational Firms in Advanced Capitalist Countries." In the course of that work, I edited three books. Two books studied the productivity gains from human resource management practices, and one studied the structure of wages within and across firms in Organization for Economic Cooperation and Development ("OECD") countries. For this and earlier work, I have raised $2.95 million (with other principal investigators) from the National Science Foundation, the Alfred P. Sloan Foundation, the Russell Sage Foundation, the Rockefeller Foundation, and the Department of Labor.

11. I have also worked with or studied firms in the finance industry many times. I have an ongoing research project on a finance firm, though the confidential nature of the work prevents me from providing the company name. For context, however, the firm is larger than Goldman Sachs. In addition, over the last 15 years, I have utilized business school cases on finance firms in my people management courses. I have also written two Stanford Graduate School of Business cases on people management practices at Royal Bank of Canada, which is one of the big five banks in Canada.

12. For nearly 20 years, I have been studying technology companies in Silicon Valley. From 2005 to 2007, I developed and taught a course at Stanford on Managing Talent in which one tool used was to analyze the compensation practices of about forty companies in Silicon Valley. During this course,

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everyone in this seminar went to these firms and met with company CEOs, high-level managers, engineers, and other managers and individual contributors. Using a question and answer format, we discussed companies' policies on compensation, performance evaluation, the links between evaluation and pay, bonuses, equity, and promotions. We also studied how companies attract and select new employees, how they award and retain star performers, and how they address outside offers.

13. I also recently worked with a team of researchers to study how firms in the software industry attract and compensate star talent, using a unique data set on the compensation and careers of about 50,000 software employees. Our focus was to investigate the relationship between different software product types and worker compensation in the software industry. In particular, we examined how firms in a product line where "home run" products matter attract and pay star employees. Our investigation was based on a rich longitudinal data set matching employers and employees. Specifically, we measured both earnings levels and earnings growth due to pay increases within firms and job-hopping between firms. We used this rich data source to investigate the connection between the payoff to high stakes products and the rewards to stars in the software industry. In short, our analysis revealed that firms that operate in "home run" product markets will pay stars both higher starting salaries and higher performance pay. The highest skilled stars are much more highly valued and paid than those who are slightly less skilled.

14. Prior to my time at Stanford, I taught and researched labor economics, personnel economics, and insider econometrics at Carnegie Mellon University from 1981 through 2003. As a part of this work, I used production-level data from firms in the steel industry to model the effects of alternative management strategies on productivity. I have also studied the productivity gains from information technologies in other manufacturing industries.

15. I am being compensated at my standard billing rate of $1,200 per hour. I have been assisted in this matter by staff of Cornerstone Research, who worked under my direction. None of my compensation in this matter is contingent on the content of my opinion in this matter or the outcome of this matter. My CV is attached as Appendix A.

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1.2. Overview of Plaintiffs' allegations

16. Plaintiffs bring this action on behalf of a class of current and former female professionals employed by Goldman Sachs ("GS") who hold (or held) the corporate titles of Associate or Vice President ("VPs") in three revenue-generating divisions: Investment Banking ("IBD"), Investment Management ("IMD"), and Securities.[1] The class covers professionals working at GS's New York office from July 7, 2002 through the present, and professionals working at GS's other U.S. offices from September 10, 2004 through the present.[2] Plaintiffs allege that GS discriminated against class members through three human resource management processes certified by the court—the 360 review, manager quartiling, and cross ruffing (the vetting process used to evaluate candidates for promotion to Extended Managing Director ("EMD")).[3]

- **Disparate Impact Claim:** Plaintiffs allege that GS employs three facially neutral processes that have a disparate impact on women in compensation and/or promotion.[4]

- **Disparate Treatment Claim:** Plaintiffs allege that GS has engaged in widespread intentional discrimination against women in compensation and promotion by continuing to employ those processes despite knowing that they have a disparate impact on women's compensation and promotion.[5]

17. With respect to their **disparate impact** claim, Plaintiffs challenge a set of GS's allegedly "common" review and promotion processes.

- **Evaluation:** Plaintiffs challenge two processes related to performance evaluation: 360 review and manager quartiling.[6] Plaintiffs allege that these processes cause women to be paid and promoted less than comparable men.

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[1] Op. & Order Granting in Part Pls.' Mot. to Certify the Class Pursuant to Rule 23(b)(3), March 30, 2018, p. 4, ECF No. 578 ("Op. & Order").

[2] Op. & Order, p. 4. I understand that certain class members who executed particular agreements to arbitrate their disputes with Goldman Sachs are no longer part of the class. However, I include them in my analysis because Plaintiffs' expert, Prof. Henry Farber, includes them in his analyses (making some adjustments to his sample in his damages section). For simplicity, throughout the report I use "class member" to refer to current class members as well as these former class members.

[3] Op. & Order, p. 4. See also Expert Report of Wayne F. Cascio, January 15, 2021, ¶ 16 ("Cascio Report").

[4] Op. & Order, p. 4.

[5] Op. & Order, p. 4.

[6] Pls.' Resps. & Objs. to Defs.' Third Set of Interrogs., p. 5.

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» **360 Review:** Although Plaintiffs acknowledge that a 360 review process "arguably could be constructed to provide valid developmental feedback," they claim nonetheless that it "is an improper tool to make compensation and evaluation decisions" because "there are numerous design and implementation deficiencies that render it unreliable and invalid,"[7] including that reviewers are allegedly "not trained to value the same performance similarly."[8] Plaintiffs allege that, as a result, female Associates and Vice Presidents receive lower 360 scores than similarly situated men.[9] According to Plaintiffs, the disparity in 360 scores also impacts manager quartile assignments, which Plaintiffs claim rely, in part, on the results of the 360 review process, and also impacts compensation and promotion.[10]

» **Manager Quartiling:** As with the 360 review, Plaintiffs claim that the manager quartiling process suffers from "design and implementation deficiencies," including "inadequate training and ineffective monitoring."[11] Plaintiffs also allege that the manager quartiling process is flawed because managers are afforded discretion and there are no procedures to ensure that the process is objectively applied.[12] Plaintiffs allege that this results in gender-biased assignments of quartiles, which contributes to gender-based pay and promotion differences.[13]

• **Promotion:** Plaintiffs allege that GS's "cross-ruffing" process for promotion from Vice President to Managing Director systematically disadvantages women. Plaintiffs' primary criticism is that the promotion process is "invalid and opaque."[14] Plaintiffs claim that their statistical analyses show that female Vice Presidents are promoted at a statistically significantly lower rate than male Vice Presidents.[15]

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[7] Memorandum in Support of Plaintiffs' Motion for Class Certification, July 1, 2014 ("Plaintiffs' Class Cert Motion"), p. 5. See also Cascio Report, ¶ 12.

[8] Plaintiffs' Class Cert Motion, p. 6.

[9] Plaintiffs' Class Cert Motion, pp. 6–7.

[10] Plaintiffs' Class Cert Motion, p. 7. See also Cascio Report, ¶ 16.

[11] Plaintiffs' Class Cert Motion, p. 8. See also Cascio Report, ¶ 13.

[12] Plaintiffs' Class Cert Motion, p. 10. See also Cascio Report, ¶ 13.

[13] Plaintiffs' Class Cert Motion, pp. 9, 13. See also Cascio Report, ¶ 16.

[14] Plaintiffs' Class Cert Motion, p. 11. See also Cascio Report, ¶ 14.

[15] Plaintiffs' Class Cert Motion, pp. 11–12.

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18. With respect to their **disparate treatment** claim, Plaintiffs allege that GS engaged in a pattern or practice of intentional discrimination because GS was aware that the challenged 360 review, manager quartile, and promotion processes adversely impacted female class members, including with respect to compensation and promotion to Managing Director, "but did not adjust [its] policies or practices to account for the discrimination women faced."[16]

1.3. Assignment

19. On January 15, 2021, Plaintiffs' expert Prof. Henry Farber submitted an expert report in which he opines that in some years, GS's 360 review, manager quartiling, and cross-ruffing processes are systemically biased against women, and that, as a result women class members are paid and promoted less than similarly situated men.[17] From 2016 to 2018, Prof. Farber finds no evidence of bias in the 360 review process or manager quartiling, though he continues to allege some damages for this period.[18] Prof. Farber finds an alleged shortfall in the overall number of women promoted to Extended Managing Director ("EMD"). More specifically, Prof. Farber finds that conditional on variables he controls for in his model, more women are promoted from VP to than one would expect based on their qualifications in 2010, 2012, and 2015, while fewer women than expected are promoted in other years. He does not evaluate the statistical significance of the annual differences in the number of men and women's promotions.

20. Taken all together, Prof. Farber estimates that back-pay damages associated with alleged gender bias in the challenged 360 review and manager quartile processes total $17.8 million for Associates and $170.2 million for Vice Presidents, plus a one-time "pay parity" adjustment of $9.2 million for VPs.[19] Prof. Farber alleges that gender differences in promotion to EMD are associated with $170.9 million in damages.

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[16] Op. & Order, p. 34.

[17] Expert Report of Henry S. Farber, January 15, 2021, ¶¶ 7–18 ("Farber Report").

[18] Farber Report, ¶¶ 114, 123–124, 138.

[19] Farber Report, ¶¶ 14, 16. If one excludes opt outs, individuals with Severance Agreements, MD Agreements, and Private Wealth Management Agreements, the back-pay damages numbers fall to ████████ for Associates and ████████ for VPs (Farber Report, Table 26).

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21. GS's counsel have asked me to review Prof. Farber's report and analyze the following questions:

- Are the analyses and conclusions presented by Prof. Farber accurate and reliable?

- Does statistical evidence support Plaintiffs' claim that GS's review processes (e.g., the 360 review and manager quartiling processes) are systemically biased or produce disparate impact against the class members?

- Does statistical evidence support Plaintiffs' claim that GS's "cross-ruffing" process for promotion from Vice President to Managing Director is systemically biased against female Vice Presidents in the alleged class, and therefore causes class members to be promoted at lower rates than comparable men?

- Does statistical evidence support Plaintiffs' claim that alleged bias in GS's review processes *causes* class members to be paid less than comparable men or promoted to Managing Director less frequently than men?

- To the extent Prof. Farber's calculations of alleged classwide damages are admissible (I understand they are not), are they reliable and accurate?

22. In addressing these questions, I have relied on numerous sources of information, including documents produced by GS, deposition testimony, and declarations from GS professionals. I have also relied extensively on information from several databases produced by GS in this matter. This data covers class-relevant professionals and their male counterparts spanning the beginning of the class period (2002) through 2018. I also reviewed the expert reports and statistical backup of Prof. Farber.

23. I list the documents I considered in forming my opinion in Appendix B.

24. My work in this matter is ongoing, and I reserve the right to supplement or amend my report, including in response to additional opinions offered by Plaintiffs' experts or additional discovery.

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2. SUMMARY OF OPINIONS AND OVERVIEW OF REPORT

2.1. Summary of opinions

25. I have reviewed Prof. Farber's methodology and conclusions. The regression models that Prof. Farber relies on to estimate the alleged "bias" in GS's review and promotion processes suffer from two fundamental flaws that render his analysis incapable of answering the central question in this case: do the challenged review and promotion processes lead to a common, systemic gender gap that disfavors women in reviews, promotion, and compensation? Prof. Farber simply does not answer this question, for two principal reasons.

26. First, he does not actually test whether there is a *common, systemic* gender gap that disfavors women for these processes. The first step for an economist in determining whether a particular process produces a systemic effect is to understand how and by whom the process is applied. Then, the economist must consider whether statistics tells us that the process produces the *same* effect across its various applications, or, conversely, whether that the effect is *not* the same across the various applications. Prof. Farber does not do any of this. He merely tests whether, averaged across all applications of the challenged processes, there is a difference between outcomes for men and women, which is not the same as proving that the challenged processes exhibit systemic gender bias (and indeed, as I explain below, they do not).

27. Second, Prof. Farber's regression model is flawed in its construction, both because Prof. Farber omits key variables—namely, individual performance metrics and job function variables that are critical to performance and promotion outcomes—and because he fails to separate his models by division, even though the evidence is clear that the processes function differently *at least* at this level, and indeed across smaller units (Business Units, managers, etc.) as well. As just one example, different divisions use different measures of productivity when analyzing performance.

28. As a result of these errors, Prof. Farber's analysis *assumes*—rather than tests—that the challenged processes lead to a common, systemic gender gap and also suffers from omitted variable bias.

29. When I correct these flaws in Prof. Farber's analyses and directly test whether there is common bias in the challenged processes, I find that:

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- The statistical evidence rejects the claim that there is a common, systemic gender gap with respect to the 360 review process, the assignment of manager quartiles, or promotion to EMD at GS during the relevant period.

- The statistical evidence rejects the claim that there is a common, systemic gender gap in compensation, irrespective of the cause.[20]

- The statistical evidence rejects the claim that alleged gender gaps in the challenged processes *cause* an alleged gender gap in compensation. As a result, there are no damages in this case.

- To the extent opinions about alleged classwide damages are admissible at all (I understand they are not), given that there are no common gender gaps in the challenged processes and no impact of such a gap on compensation, there are no damages. Aside from failing to account for this fundamental point, Prof. Farber's "damages" estimates are also riddled with errors and completely unreliable.

30. In the remainder of this section, I provide a brief overview of my report and its key findings.

2.2. Overview of report

31. In **Section 3**, I begin my analysis by detailing the two critical features of GS's review process that Prof. Farber ignores in his analysis: organizational structure and job hierarchy. Prof. Farber's failure to account for these critical features render his analysis incapable of addressing the relevant questions in this case.

- **First,** Prof. Farber ignores the fact (supported by documents, testimony, and data) that the thousands of professionals at Goldman Sachs who held the corporate titles of Associate and VP during the relevant period engaged in different "jobs": They performed different functions in different divisions and in different Business Units, and they performed roles that required different skills and that were evaluated using

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[20] I understand that Prof. Farber's opinions regarding compensation and class-wide damages will not be admissible at trial. Nevertheless, I have been asked to review his analysis and asses its reliability to the extent his opinions are admitted, i.e., for rebuttal purposes only.

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different measures of productivity.[21] Prof. Farber conducts his analysis as if there are only *two* jobs at Goldman Sachs that are the same across all divisions and Business Units: Associate and VP. Applying this flawed approach, Prof. Farber omits important data that matter to review, compensation and promotion decisions, such as job function and measurable contributions to firm performance ("production") (**Section 3.1**).

- **Second,** Prof. Farber ignores the fact that the challenged processes at GS are implemented by hundreds of different decision makers across subunits of GS, and that each of these people has the discretion to evaluate the performance, compensation, and promotion of a given professional based on the professional's specific role. As just one example, 360 scores at GS are assigned to each professional by a set of reviewers selected by that professional with input from her performance manager,[22] resulting in different combinations of reviewers for each class member. For example, the 23 reviewers who ever reviewed named Plaintiff De Luis *never* reviewed 97 percent of the other class members.[23] Because the 360 process is decentralized in this fashion, the 360 reviewers in each of the three divisions at issue in this case differ from one another. In fact, as I show in Exhibit 1, there is very little overlap in reviewers across the divisions, suggesting no mechanism for systemic bias. Similarly, groups of professionals who are in the same Business Unit, or who share the same performance manager, are reviewed by unique sets of reviewers: There is very little overlap in the reviewers associated with any given pair of Business Units, performance managers, or individual professionals (**Section 3.2**)

32. In **Section 4**, I emphasize that Prof. Farber's choice to ignore these key features of GS's processes by using just one regression model for each corporate job title renders his statistical methodology unreliable because he **assumes,** rather than tests, that the challenged processes generate a common gap across different sets of reviewers. For example, **he assumes that the alleged bias**

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[21] An important distinction in this report is between "job" and "title." As a labor economist, I define a job as a set of roles and responsibilities that require specific skills to execute that are valued differently in the labor market. A corporate title like "Vice President" is simply a way that a firm (like GS) categorizes a broader set of jobs for internal organizational purposes. As I explain in Section 3, the available data allow me to distinguish different jobs using variables such as Business Unit and function, and the available testimony from GS indicates that even employees in the same Business Unit and/or function often have different roles and responsibilities that require different skills.

[22] I discuss the role of performance managers at GS in Section 3.2.1; see ¶ 97.

[23] See Workpaper 1.

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in 360 review scores is the same across divisions and across Business Units even though reviews are conducted by distinct sets of reviewers across those organizational units and across professionals, and even though professionals in different organizational units perform different jobs. This point is made clear, for example, in Exhibit 1 below, which shows that nearly all 360 reviewers review professionals in only a single division. Prof. Farber also fails to use variables that are available and that can help explain the outcomes of processes he analyzes.

Exhibit 1
Nearly all 360 reviewers review professionals in just one division

Reviewers in 2015
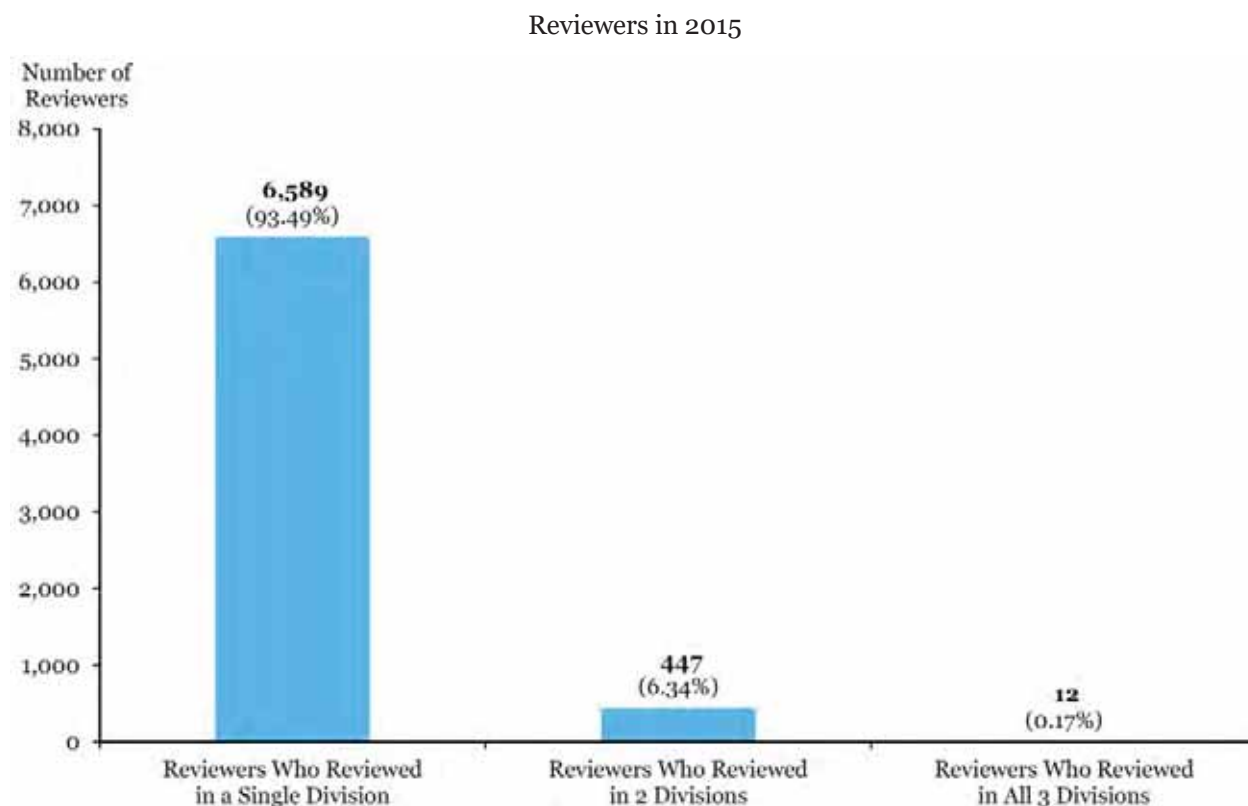
See: Exhibit 16

33. In **Section 5,** I explain how my models correct for Prof. Farber's errors. In **Section 5.1,** I show that, when gender gaps in the 360 review process are analyzed at the appropriate level of decision-making (i.e., at the very least by division), and when I include production metrics in the regression model that Prof. Farber excludes, Prof. Farber's finding of a common gap in 360 review scores does not hold. Specifically, my model shows that:

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- Gender gaps in the 360 review **are statistically different across division and time period**. Because Prof. Farber finds no evidence of bias in Overall Manager Ratings ("OMRs") during 2016 to 2018 for any class members, there is no claim of bias from that period for me to respond to.[24] I also find no evidence of systemic bias in the earlier 360 review frameworks. Taken together, there are no significant gender gaps in 14 of 18 division-time period groups.[25] In four groups, gender gaps are significantly adverse to women. (**Section 5.1.1**)

- Gender gaps across individual Business Units are also statistically different from each other, and **in a number of groups significantly favor women relative to men**. Exhibit 2, for example, shows my results for Associates in IMD and Securities and Junior Bankers in IBD. The light blue bars are Business Units where gender gaps for 360 reviews *are not statistically different from zero*. The dark blue bars identify Business Units where the gender gaps are statistically significant, and as Exhibit 2 makes clear, in many of these Business Units, the gaps favor women (i.e., are above the line). Overall, 85 percent of class members worked in Business Units that had estimated gender gaps for 360 reviews that are either statistically significant in **favor** of women or not statistically different than zero.[26] (**Section 5.1.2**)

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[24] The OMR replaced the numeric 360 score in 2016. I discuss the OMR in detail in Section 3.2.

[25] Prof. Farber and I agree that the 360 review should be analyzed by three time periods, reflecting three changes in scale over time. Thus, he analyzes six groups of data for the 360 review (the three time periods separately for Associates and VPs). The necessary step of separately modeling the three divisions results in 18 groups of data.

[26] See backup to Exhibit 2. As described more fully in Section 5.1.2, I also run a commonly used statistical test (F-test) to directly test whether the gender gaps in 360 scores are statistically significantly different across Business Units. I find that they are: There is statistically significant variation in the gender gap in 360 scores across Business Units.

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Exhibit 2

There is no common gender gap in 360 review scores at Goldman Sachs

Associates and Junior Bankers by Business Unit, 2005–2015
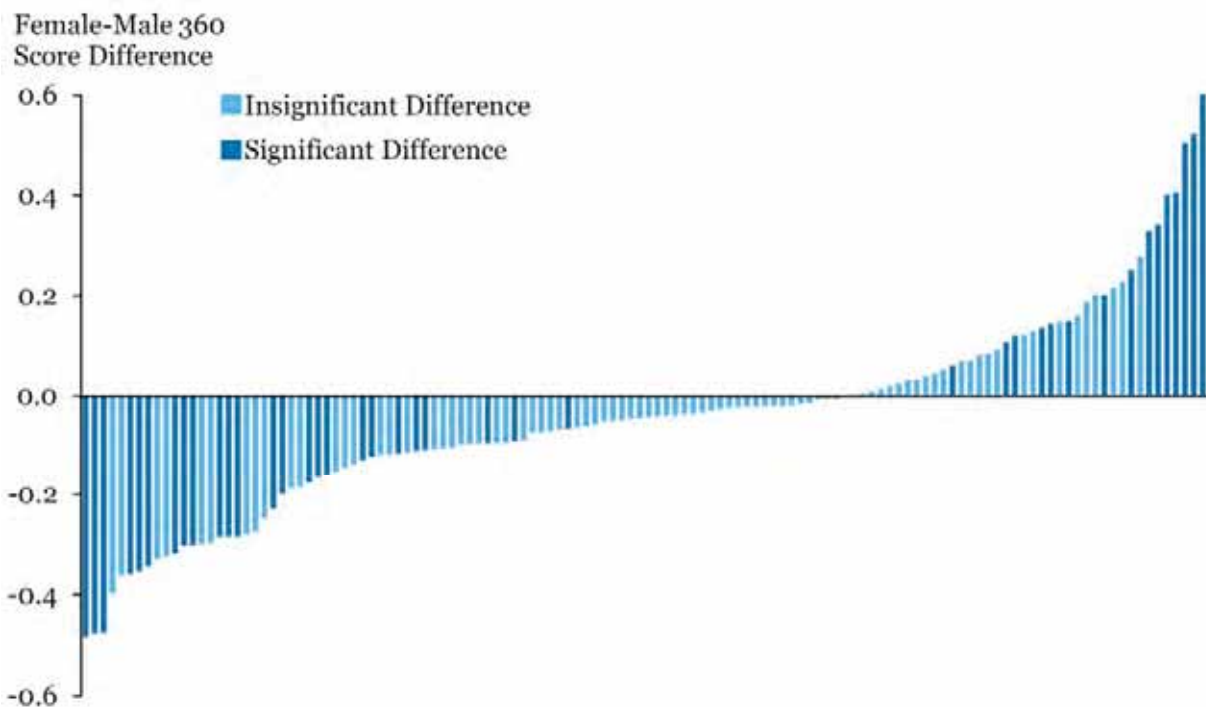
See: Exhibit 22

- Further, even in subgroups where women receive 360 review scores that are, on average, lower than those received by men, many individual women have scores higher than would be predicted for comparable men. Indeed, across divisions, years, and titles, 48 percent of women have higher 360 review scores than the model predicts for comparable men.

- Taking Securities VPs in Exhibit 3 as an example, all of the blue dots above the diagonal line represent women who received 360 review scores higher than my model predicts for comparable men, and ▮▮▮▮▮ ▮▮▮▮▮▮▮▮▮▮▮ (the orange dot) is an example of this.[27] If gender explained the difference between women and men's 360 review scores, we would see a different pattern: blue dots would consistently lie below the diagonal line, indicating that women earn lower 360 scores than predicted for comparable men. Instead, we see women earning scores far above and far below what my model predicts for comparable men. This

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[27] Both Allison Gamba and Mary De Luis received higher 360 review scores than a comparable male in at least one year. In her single full year at GS, Shanna Orlich received a lower score than a comparable male. I am unable to conduct a similar analysis for Cristina Chen-Oster because she left GS before the start of my analysis sample. See backup to Exhibit 3.

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exhibit shows that gender explains very little of the difference between women and men's 360 review scores, suggesting that even after correcting for Prof. Farber's errors, there are still many factors not available to be included in the model—factors other than gender—that explain these differences. The pattern I observe rejects Plaintiffs' claims of systemic bias common to all class members (**Section 5.1.3**).

Exhibit 3
Many women earn 360 review scores that vary widely from, and are higher than, the predicted scores of comparable men
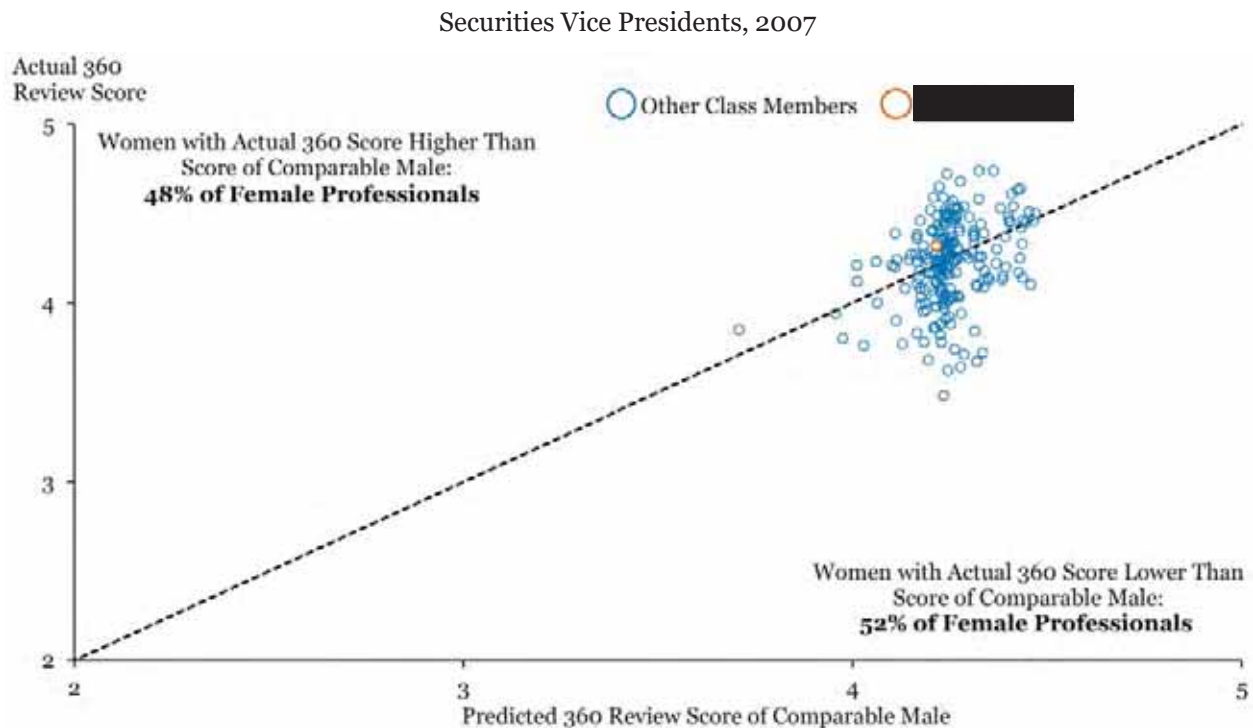
See: Exhibit 23. Each circle represents a specific woman.

34. In **Section 5.2**, using my model, I find similar results for manager quartiles.

- As with the OMR, because Prof. Farber finds no evidence of bias in manager quartiling in 2016 to 2018 for any class members, there is no claim of bias in manager quartiling during that period for me to respond to. Regarding the period before 2016, I also find that there is no common gender gap in manager quartiling. In fact, I find no significant gender gaps in five out of six division-corporate job title groups prior to 2016.

- Similarly, gender gaps in manager quartiling across individual Business Units are also statistically different from each other, with a number of

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groups **significantly favoring women relative to men**. Overall, 97 percent of female VPs/Senior Bankers, and 93 percent of female Associates/Junior Bankers, worked in Business Units that had estimated gender gaps for manager quartiling that are either statistically significant in **favor** of women or not statistically different than zero.[28]

- Exhibit 4 shows the results for VPs in IMD and Securities and Senior Bankers in IBD. The light blue bars are Business Units where differences in men's and women's manager quartiles are insignificant; the dark blue bars are Business Units where manager quartiling results differ significantly by gender, with differences favoring women above the line and vice versa. Very clearly, there is no systemic bias against women in manager quartile results.

Exhibit 4
There is no common gender gap in manager quartiling at Goldman Sachs

Vice Presidents and Senior Bankers by Business Unit, 2005 – 2018
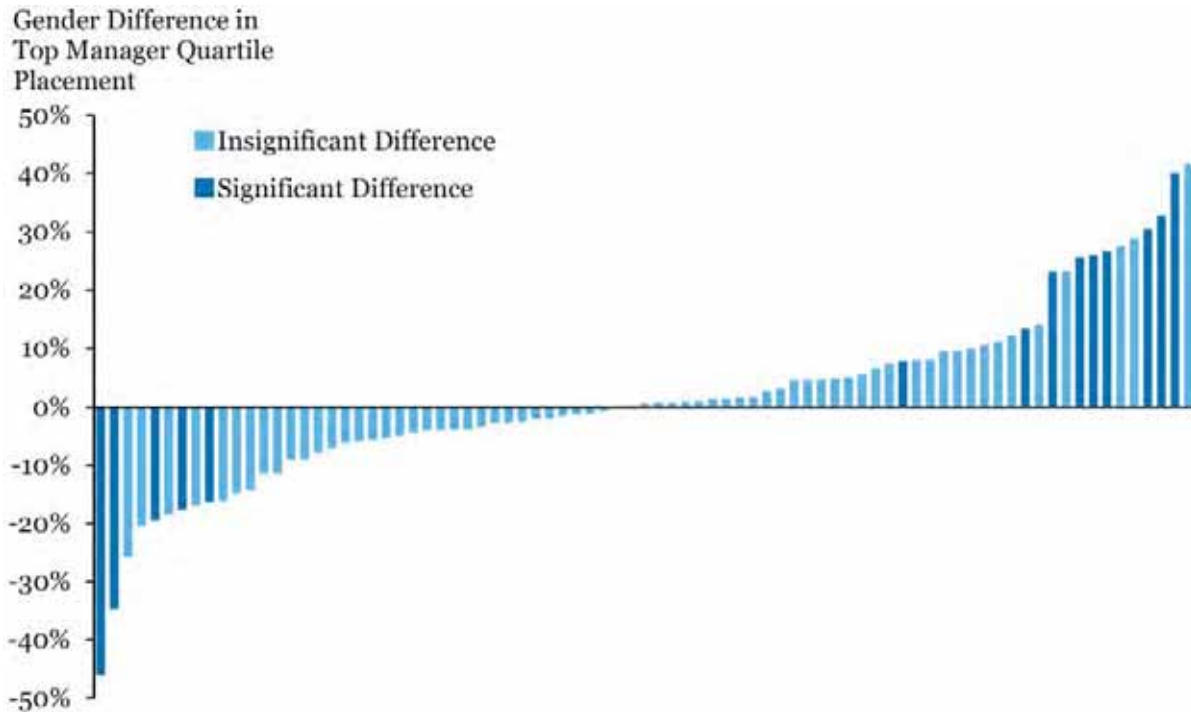
See: Exhibit 25

35. In **Section 5.3**, I turn to Plaintiffs' claim that the cross-ruffing process for promotion from VP to Extended Managing Director is biased against female

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[28] See backup to Exhibit 4. The version of the F-test for the model of manager quartiling also finds that there is statistically significant variation in the relationship between manager quartiling and gender across Business Units.

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professionals. As Exhibit 5 shows, when the flaws in Prof. Farber's promotion analysis are fixed (i.e., all relevant information is included and the analysis is done at the division level), women **are nominated and promoted to EMD at significantly higher rates than men in multiple divisions.**

- The patterns in Exhibit 5 also raise another inconsistency in Plaintiffs' claims of bias. Promotion to EMD is a significant business decision for GS. The fact that women fare as well as or better than men in the promotion process is strongly inconsistent with the claim that GS is biased against women. It would be quite inconsistent for decision makers to award 360 reviews and manager quartiles in a fashion that is biased against women, and then for decision makers to then **favor women relative to men** at the critical step of promotion. Again, a more plausible interpretation of the data is that the inconsistent gender gaps across outcomes and subgroup do not reflect bias against either women or men.

Exhibit 5
Women are nominated for promotion and promoted to EMD at least as often as—or more often than—men across all divisions

	Investment Banking	Investment Management	Securities
1. Nomination	-1.76	0.63	3.41 *
2. Promotion of nominees	7.89	1.67	6.00
3. Promotion not limited to nominees	0.49	-0.02	2.69 *

See: See Exhibit 27, Exhibit 28, Exhibit 29

36. Taken together, the results I find in **Section 5** regarding the challenged processes demonstrate that Prof. Farber's **assumption** that the average gender gaps from his regression models measure systemic bias that applies to all class members is incorrect.

- In particular, the patterns above show the flaw in relying on one *average* gender gap for Associates and one for VPs to conclude that there is *common* gender bias toward female class members in any of the challenged processes. To provide a simple analogy: if ten people work on the first floor of a building and ten people—Apple CEO Tim Cook and nine others—work on the second, there will be an average difference in income adverse to professionals on the first floor. But this average

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difference does not mean that a given professional on the first floor is paid less than similarly situated professionals on the second floor, or that there is common, systemic bias against professionals who work on the first floor.

- The fact that I find that gender gaps are **in favor of women** in some subgroups is also important. If the gender gaps measured by Prof. Farber's regression model truly captured "bias" (as he claims), then the patterns I have identified imply that GS is discriminating against both men and women at the same time using the challenged processes, depending on the relevant sub-units within the firm. Given the individualized nature of the review and promotion processes—and the many different factors that affect each professional's performance and prospects for promotion—a more reasonable interpretation of the patterns in the data is that the gender gaps measured by Prof. Farber's regression models capture unmeasured factors that vary across sub-units of the firm (for example, more complete production data, or more detailed descriptions of job function and job difficulty) rather than "bias" that moves in different directions depending on the decisions and sets of decision makers being analyzed.

37. In **Section 6** of my report, I turn to an assessment of Prof. Farber's regression model of compensation. As I explain in **Section 6.1,** Prof. Farber's compensation regression suffers from the same **two critical flaws** that infect his 360 and quartile regressions: (1) his model excludes a variety of variables that are considered in the compensation-setting process, rendering his estimate of the gender gap unreliable, (2) Prof. Farber ignores the decentralized nature of compensation decisions.[29]

38. In **Section 6.2**, I show that when Prof. Farber's model estimated separately by division, correcting the first flaw in his model, his estimated gender gaps in compensation become statistically insignificant.

- In Exhibit 6, I illustrate the result of moving from Prof. Farber's model to mine for Associates in the Securities division. When I add controls for differences in jobs and productivity that Prof. Farber excludes (orange bars, moving from left to right on the chart), the gender gap falls from 12

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[29] As noted above, I understand that Prof. Farber's opinions regarding compensation and class-wide damages will not be admissible at trial. Nevertheless, I have been asked to review his analysis and asses its reliability to the extent his opinions are admitted, i.e., for rebuttal purposes only.

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percent to a gap that is statistically insignificant (i.e., indistinguishable from zero).

- Further, my regression model explains GS's compensation setting much better than Prof. Farber's. For example, Prof. Farber's model explains just 30 percent of the variation in compensation across Associates in Securities, while my model explains 77 percent (blue bars, moving from left to right on the chart).

Exhibit 6
Adding basic control variables for job, production, and performance to Prof. Farber's model erases the "gender gap" and improves the model's explanatory power

Securities Associates
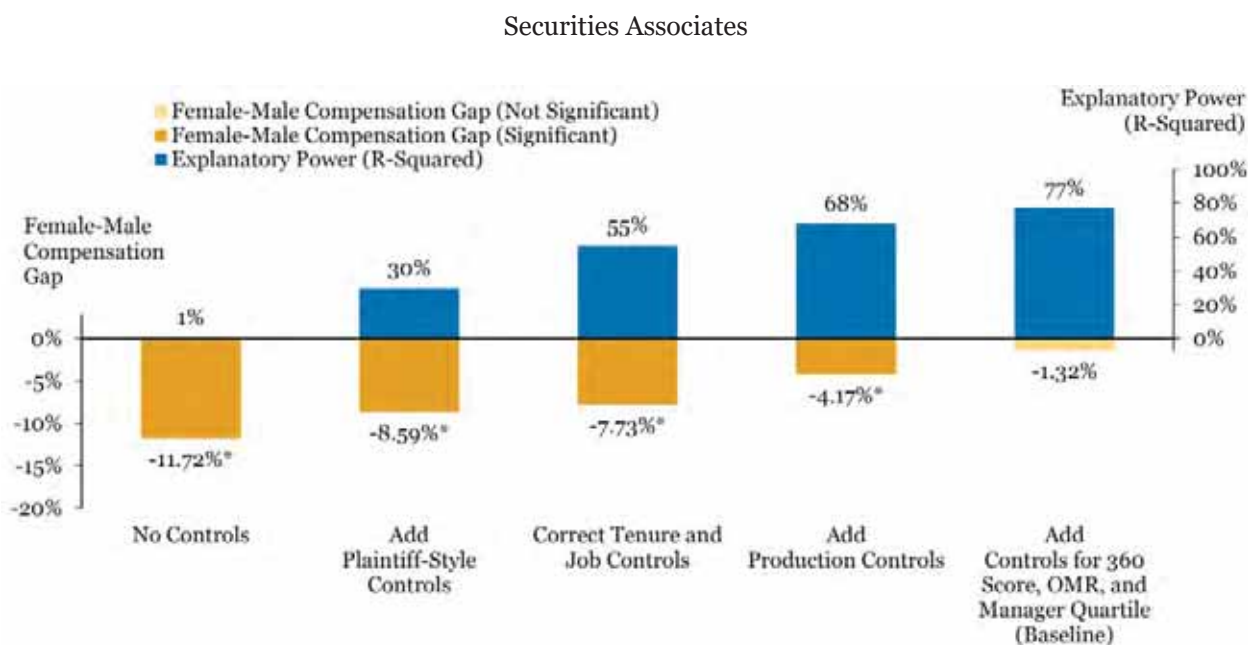
See: Exhibit 31

- More generally, for all division and corporate title combinations, when I add controls for differences in jobs, productivity, and performance reviews that Prof. Farber excludes, I find **no significant gender gap in pay for four of six division-corporate title subgroups**, and similar patterns of increasing explanatory power and shrinking gender gaps across **all six division-corporate title subgroups**.

- The fact that (a) my model has more explanatory power and (b) the alleged gender gap shrinks by such a large magnitude when I add better controls for job and productivity means Prof. Farber's regression analysis suffers from a methodological flaw called "omitted variable

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bias." The alleged "gender gap" he finds measures the effects of variables excluded from his model rather than gender.

- Further, when I adjust Prof. Farber's model to limit the influence of "outliers" by using a median regression, I find **no significant gender gaps across any of the six division-corporate title subgroups**. These results appear in Exhibit 7, and reflect the fact that the "gender gap" is due to a small number of disproportionately male professionals with extraordinarily high compensation. These professionals' pay is not predicted well by a regression model for professionals generally, a fact that must be accounted for when constructing the model—otherwise the model will not predict pay well for any members of the population. Excluding outliers from the model (displayed below in Exhibit 7, row 1) is one way to account for this issue. An alternative approach is to use a median regression (Exhibit 7, row 2), which accounts for outliers by estimating the gap in the middle of the pay distribution only. Removing compensation outliers, four division-corporate title groups have no significant gaps, one has a significant gap adverse to women, and one has a significant gap that *favors* women. Using the median regression, there are **no significant gender gaps in compensation**.

Exhibit 7
After accounting for outliers, there is no common gender gap in compensation

| Specification | Investment Banking | | Investment Management | | Securities | |
	Junior Bankers	Senior Bankers	Associates	Vice Presidents	Associates	Vice Presidents
1. Removing Compensation Outliers	0.65%	-3.86%	2.43% *	-4.25% *	-0.02%	-2.56%
2. Median Regression	0.53%	-2.13%	0.81%	-3.47%	-1.25%	-1.55%

See: Exhibit 34, Exhibit 35

39. In **Section 6.2.4**, I explore how the gender gap in compensation varies across different decision-making units within GS, namely Business Units, using my compensation model.

- I find that gender gaps across different Business Units are frequently statistically insignificant, and **sometimes favor women.** Overall, 93 to 95 percent of women VPs in IBD, IMD, and Securities worked in

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Business Units in which, as a statistical matter, women were paid the same as or more than men.[30]

- As an example, in Exhibit 8, I show gender gaps by Business Unit for Vice Presidents in IMD and Securities and Senior Bankers in IBD. As with other exhibits, light blue bars show insignificant gaps while dark blue bars show significant gaps. Exhibit 8 makes clear that **women are paid significantly more than men in some Business Units,** a particularly relevant fact. Again, under Prof. Farber's methodology, this pattern implies GS is discriminating against men in those units based on gender. These types of patterns highlight why Prof. Farber's methodology of treating gender coefficients from his or my regressions as a measure of "bias" is unreliable: It is contradictory to claim, as Prof. Farber's logic suggests, that there is systemic bias against men in some Business Units and women in others. My results reject Prof. Farber's assertion that gender gaps reflect systemic bias, and instead suggest that these gender gaps reflect missing information not available in the data. In other words, even with the fullest regression models, many relevant variables are still missing from the model (for example, complete production data and job function information), and it is likely that those missing variables, not gender, that account for differences between men and women.

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[30] See Exhibit 38.

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Exhibit 8

There is no common gender gap in compensation at Goldman Sachs

Vice Presidents and Senior Bankers by Business Unit, 2005–2018
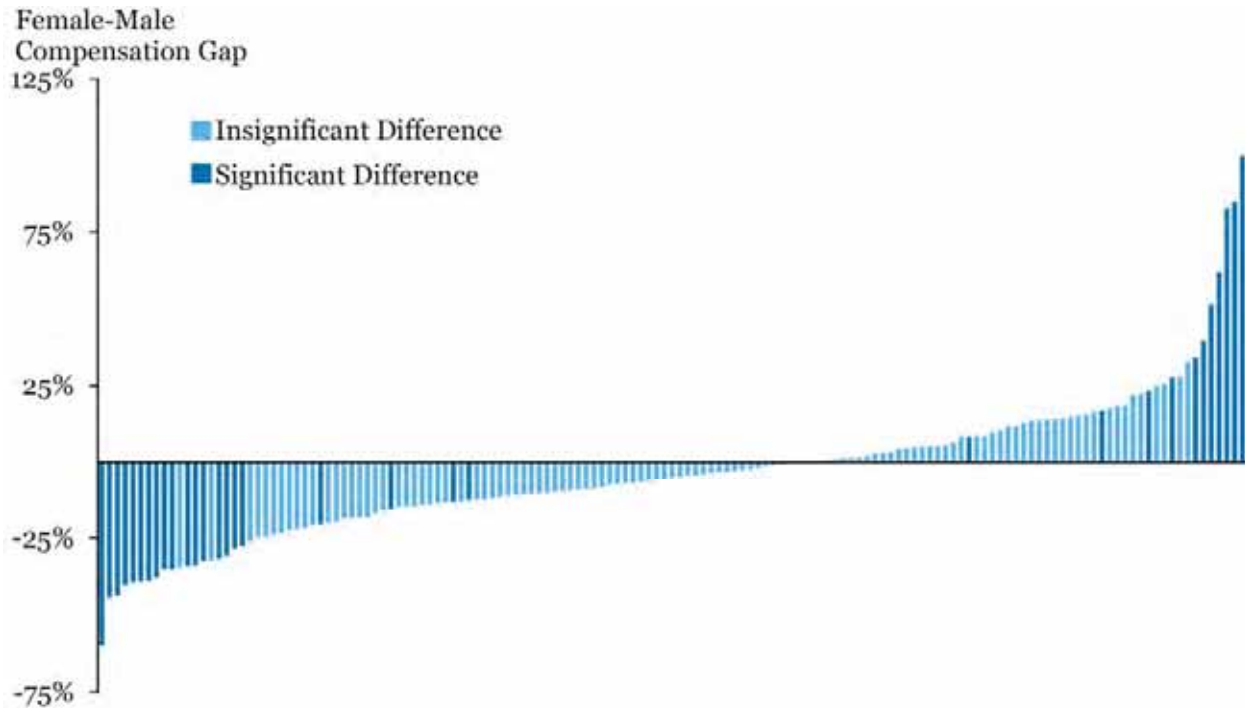
See: Exhibit 37

40. In **Section 6.3**, I show that, even in subgroups where the regression model finds that, on average, men earn more than women, **many individual women make more than comparable men.**

41. A specific example of this concern is named Plaintiff Allison Gamba. In 2012, Ms. Gamba earned ███████.[31] Using my regression model, I can predict the PATC for a man whose characteristics in the data are _identical_ to Ms. Gamba's (i.e., a comparable man): such a man would have earned around ██████, on average. In other words, according to the model, Ms. Gamba _earned more_ than a comparable man.[32]

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[31] This corresponds to her Per Annum Total Compensation ("PATC"). PATC reflects total pay (including salary and bonus) and is annualized when a professional only worked part of a given year.

[32] Mary De Luis had similar compensation to the predicted compensation of a comparable male in her last year in the data, and lower compensation than the predicted compensation of a comparable male in the prior two years. In the one year she appears in my analysis sample, Shanna Orlich had lower compensation than a comparable male. I am unable to conduct a similar analysis for Cristina Chen-Oster because she left GS before the start of my analysis sample. See backup to Exhibit 9.

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- Exhibit 9 shows that Ms. Gamba is not unique. For example, in the case of Vice Presidents in the Securities division in 2015, 47 percent of women earned more than a comparable male as predicted by the regression. (**Section 6.3.2**)

Exhibit 9
Many women earn compensation that varies widely from, and is higher than, the predicted compensation of comparable men

Securities Vice Presidents, 2015
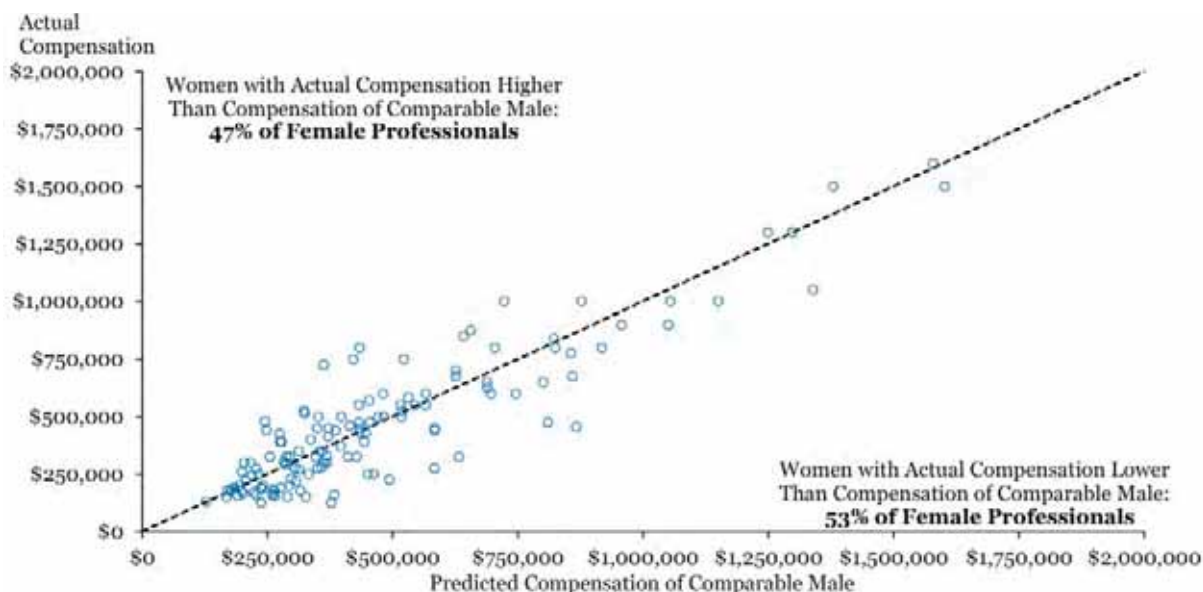
See: Exhibit 40

42. In **Section 7**, I address Prof. Farber's analysis of alleged damages. At the threshold, I understand that classwide damages are not at issue in this case, and that Prof. Farber's opinions on this topic are not admissible under the court's orders. I respond to his analysis as pure rebuttal, in case his opinions are admitted at trial, by showing that his methodology and assumptions are flawed for two primary reasons.

- **First,** because damages in this matter are limited to harm that is caused by an alleged disparate impact of the challenged processes, there are no damages. Using my corrected models of the challenged processes, I find no evidence of systemic bias against women in those processes; and as detailed above, my analysis rejects the proposition that the average gender differences in the review processes measured by Prof. Farber's regression models capture gender "bias." Thus, I conclude that there are

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no damages caused by bias in the 360 review, manager quartiling, or promotion processes.

- **Second,** even if one were to accept Prof. Farber's faulty claim that average gender differences in performance reviews measured by a regression model reflect "bias" in the review processes (and the implication that GS discriminated against both men and women depending on subgroup), his analyses are flawed in numerous other ways that inflate damages. But again, using my corrected models, there is no evidence of common bias in these processes, so there cannot be any damages.

43. In summary, the findings in this report refute Plaintiffs' allegation of systemic gender bias at GS. Under Plaintiffs' theory, there should be a pattern of negative, significant gender gaps across *all* groups of decision makers and outcomes that Prof. Farber and I analyze. However, I find that women do just as well as men—and sometimes significantly *better* than men—on many metrics, including 360 scores and manager quartiling in some years and divisions, and promotion from VP to EMD in all three divisions. If GS's processes enable systemic discrimination, there should be a clear and consistent pattern of gender gaps adverse to women across all of these dimensions. This is simply not the case.

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3. OVERVIEW OF GS'S ORGANIZATIONAL STRUCTURE, MANAGEMENT HIERARCHY, 360 REVIEW PROCESS, MANAGER QUARTILING, PROMOTION PROCESS, AND COMPENSATION SETTING

44. To build a statistical model, one must understand the underlying environment that one is modelling.[33] In the case at hand, this means having a descriptive understanding of the 360 review, manager quartiling, promotion processes, and compensation setting at GS. What do these processes seek to account for, how are they conducted within the firm, and who conducts them?

45. This descriptive understanding is crucial to building a regression model that accurately captures the decision making process at GS and that properly controls for key economic variables—like job assignments, responsibilities, and productivity. The regression analysis of compensation needs a clear model of the relationships between the factors that determine pay as reflected in the review processes in order to be valid.

46. If an analysis does not properly reflect the true underlying processes that drive different review scores, compensation, and promotion rates for different professionals at GS, then the analysis can be subject to statistical problems that will make the analysis unreliable. [34] For example, if one does not know that compensation is primarily set within Business Units, one might not know to test whether there are gender differences in compensation across different BUs. Or, if one does not realize that sales credits are an important measure of productivity for certain VPs in Securities, one would not know to include this variable in a regression model of 360 reviews, manager quartiling, compensation, or promotions. In this section, I discuss the details and context of GS's processes in a thorough way that enables me to expand upon and correct the models and analyses set forth by Prof. Farber in his report.

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[33] James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Third Edition Update, (Pearson, 2015), p. 320 ("The second step is to ask yourself: What are the most likely sources of important omitted variable bias in this regression? Answering this question requires applying economic theory and expert knowledge, and should occur before you actually run any regressions; because this step is done before analyzing the data, it is referred to as *a priori* ('before the fact') reasoning.").

[34] These statistical problems include omitted variable bias and misspecification error. See Daniel L. Rubinfeld, "Reference Guide on Multiple Regression," in *Reference Manual on Scientific Evidence*, Third Edition, (Washington, DC: The National Academies Press, 2011), pp. 303–357 at p. 314 ("Failure to include a major explanatory variable that is correlated with the variable of interest in a regression model may cause an included variable to be credited with an effect that actually is caused by the excluded variable... As a result, the omission of an important variable may lead to inferences made from regression analyses that do not assist the trier of fact."); and Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, Fifth Edition, (Mason, OH: South-Western Cengage Learning, 2012), p. 304 ("A multiple regression model suffers from functional form misspecification when it does not properly account for the relationship between the dependent and the observed explanatory variables... Misspecifying the functional form of a model can certainly have serious consequences.").

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3.1. GS's organizational structure and management hierarchy include many different jobs that require different sets of skills, and these skills are valued differently in the labor market

47. At issue in this case are three broad divisions at GS: Investment Banking, Investment Management, and Securities. Exhibit 10 displays the organizational structure of the units within GS. As shown in the exhibit, within each of the three divisions are many Business Units, each of which has its own management and leadership, Profit & Loss ("P&L"), and business objectives. As I explain below, the divisions and Business Units capture the different sources of business or revenue that the firm seeks (Section 3.1.2 on Divisions and Section 3.1.3 on Business Units).

48. Business Units, in turn, contain professionals who occupy a variety of different, well-defined functions that are tracked in the available data (Section 3.1.4 and Section 3.1.5). As I show below, testimony in the record indicates that even within a function, professionals often have different jobs and skills and, therefore, different compensation. GS leaders indicate that jobs and duties vary greatly across divisions because they reflect the differences in the types of client services provided by each division.

Exhibit 10
Each division includes a variety of jobs
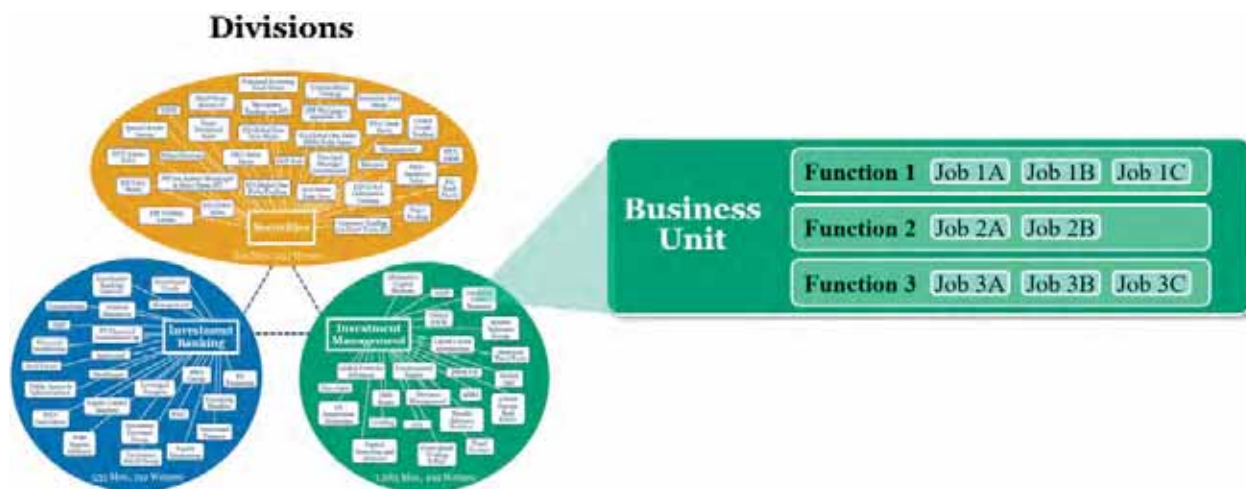
3.1.1. *Overview of the number or professionals in GS's three divisions at issue*

49. For reference, in Exhibit 11 I present the distribution of the number of class members and male counterparts by division and corporate job title. These

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individuals will form the sample I use to conduct my analyses.[35] I count each professional once for each year in which he or she was in a class-relevant position at GS.[36] I also show the number of unique Business Units and functions within each division in 2018.

Exhibit 11

Distribution of person-years for class members and male counterparts, by division and corporate job title, 2003–2018
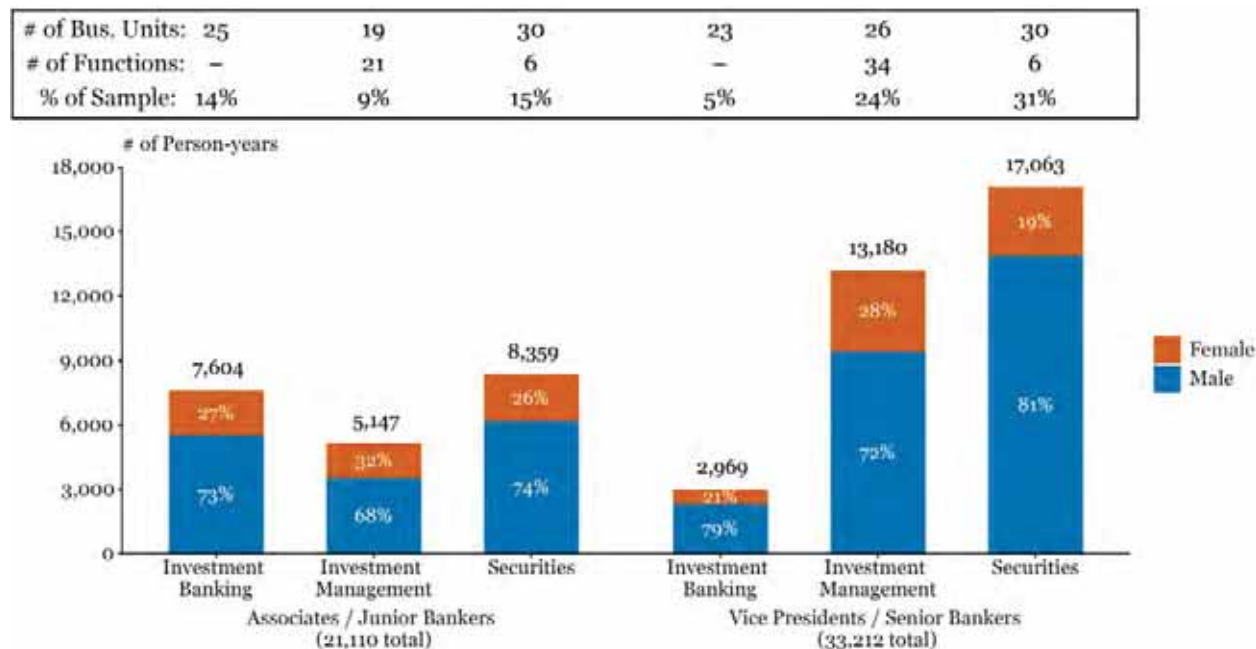
Source: Goldman Sachs Data Production

Note: Chart shows the number of female and male person-years by division and corporate job title in the period of 2003–2018 for Investment Banking, Investment Management, and Securities. The sample consists of Associates and Vice Presidents in the relevant divisions as of the end of the fiscal year. Business Unit and Function counts are shown for 2018 only. Some Business Units contain no class relevant Associates / Junior Bankers or Vice Presidents / Senior Bankers in 2018. Function data is unavailable for the Investment Banking division.

50. In Exhibit 11, and throughout my report, I analyze VPs and Associates separately when analyzing Securities and IMD. In those two divisions, professionals with the different corporate titles of Associate and VP are treated as distinct groups in the manager quartiling and 360 review processes.[37] IBD is

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[35] In this exhibit I exclude the handful of observations where gender is listed as "Prefer not to say." For my regression analyses, I follow Prof. Farber's choice to code these few observations as "not female" (i.e., "male").

[36] Throughout the report, for ease of exposition, I use "fraction [number] of class members" to refer to the fraction [number] of class member-year observations that meet the specified criteria.

[37] See, for example, Securities kick-off email for the manager quartiling process for 2009: Email from ▮▮▮▮ to ▮▮▮▮▮▮ et al., "Action Required: 2009 Manager Rank Process - Due October 22nd - Reinsurance" with attached document "2009 Quartile File - Reinsurance.xls," October 8, 2009, GS0113951 ("Assign quartiles based on title."); Deposition of Caroline Heller Sberloti Vol. II, July 11, 2013, p. 311 ("Q. And what peer group is used, against whom is one compared? A. ... it's title within business unit."); Deposition of David Landman, April

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different. Associates and first- and second-year VPs are jointly classified as "Junior Bankers," while VPs with three or more years in IBD are classified as "Senior Bankers" in the ordinary course of business.[38] IBD employs different compensation guidelines for Junior and Senior Bankers,[39] and VPs who are Senior Bankers are assigned manager quartiles separately from VPs who are Junior Bankers.[40] In light of these distinctions, throughout my report I adopt IBD's practice and analyze IBD Junior Bankers and Senior Bankers separately. Prof. Farber's decision to group together Junior and Senior Banker VPs in his analysis is an example of him inappropriately ignoring the record on how the challenged processes and compensation setting work at GS.[41]

51. I do not delve now into the number of people shown in Exhibit 11, but will refer back to the numbers throughout the report. In my main analyses I break the data out by division, so I point out the following sample sizes for professionals over the class period: the Securities division is largest, comprising 47 percent of the sample; IMD is second, with 34 percent; and IBD is smallest, with 19 percent.

3, 2018, Exhibit 371, "IMD Manager Performance Quartiling," 2015, GS0380246 – 7 at GS0380246 ("The manager performance quartile is an assessment of an employee...relative to the employee's level of experience, position, and peer group."); "Manager Performance Quartiling," 2015, GS0375285 – 93 at GS0375288 ("Divisions should ensure that all peer groups / titles are distributed proportionally across the four above performance ratings...."); "2010 Performance Reviews Process Changes," 2010, GS0004149 – 54 at GS0004151 ("Criteria differ by title and division."); "Key Changes and Milestones," GS0113306 – 12 at GS0113310.

[38] Deposition of Bruce Larson, June 12, 2013, pp. 72–73 ("Q. And a junior banker is defined as a first-year associate through second-year VP; is that right? A. For purposes of this analysis, yes."). See also IBD compensation guidelines for 2008 to 2011, GS0116926 – 43 (see, for example, Gs0116926, "███); GS0378469; GS0378450 – 4; GS0378420; and GS0378421.

[39] IBD compensation guidelines for 2008 to 2011, GS0116926 – 43 (see, for example, Gs0116926, ██████████████████████████); GS0378469; GS0378450 – 4; GS0378420; and GS0378421.

[40] See, for example, IBD kick-off emails for the manager quartiling process for 2008: Email from Leena Choi to ████████ et al., "CRG Non-EMD Quartiling Kickoff - DUE SEPT. 17" with attached document "CRG Non-EMD Quartiling File.xls," September 4, 2008, GS0113930; for 2009: Email from █████████ to K████████ et al., "2009 IBD Quartiling Kickoff - DUE OCTOBER 19th, 5 PM EST" with attached documents "2009 Performance Quartiling Manager Toolkit.pdf" and "Global CRG.xls," GS0113932 – 3 at GS0113932; and for 2010: Email from ██████████ to ███████████ et al., "2010 IBD Quartiling Kickoff - DUE OCTOBER 13th, 5 PM EST" with attached documents "2009 Performance Quartiling Manager Toolkit.pdf" and "Global CRG.xls," GS0113940.

[41] In my baseline analyses of 360 reviews, manager quartiles, and compensation, I find similar variation in alleged gender gaps when grouping IBD professionals by their corporate titles; see Workpaper 2 and Workpaper 3.

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3.1.2. *The three divisions have different business objectives, and job duties differ substantially across divisions*

52. Publicly available materials and documents in the record show many differences in business objectives between the three GS divisions at issue. According to GS's web page, the Investment Banking Division provides strategic advice and financing for large transactions such as mergers, acquisitions, initial public offerings, and debt refinancing.[42] The Investment Management Division helps clients manage their wealth and builds and manages portfolios for institutions and individuals based on a variety of investment options.[43] The Securities Division facilitates trading for clients and makes markets for equity, fixed income, currency, and commodity products.[44]

53. Reflecting these differences in the types of client services provided by each division, declarations from GS leaders indicate that job duties performed by professionals also differ greatly across divisions. For example, Susan Benz, an Extended Managing Director in the Public Sector and Infrastructure Business Unit in IBD in 2014, noted at the time that many jobs in sales and trading within Securities require quick, individual decision making, and professionals in the division may have their performance and profits evaluated daily, in contrast to IBD professionals:

> "For Securities Division professionals in sales and trading roles, profits and losses may be measured on a daily basis. In contrast, IBD bankers are tasked less with quick decision-making and more with identifying issues and making judgments about their long-term impact."[45]

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[42] Goldman Sachs, "Investment Banking," available at https://www.goldmansachs.com/careers/divisions/investment-banking/, accessed on August 1, 2019 ("Our Investment Banking teams deliver high-quality strategic advice and creative financing solutions to our clients, including mergers, acquisitions, financing, and risk management transactions.").

[43] Goldman Sachs, "Consumer & Investment Management," available at https://www.goldmansachs.com/careers/divisions/consumer-and-investment-management/, accessed on August 1, 2019 ("Consumer & Investment Management works with a diverse range of institutional and individual clients to achieve investment goals and financial well-being and bring an innovative approach to traditional consumer banking.").

[44] Goldman Sachs, "Securities (Sales and Trading)," available at https://www.goldmansachs.com/careers/divisions/securities/, accessed on August 1, 2019 ("The Securities Division (Sales and Trading) enables our clients to buy and sell financial products, raise funding and manage risk. We make markets and facilitate client transactions in fixed income, equity, currency and commodity products.").

[45] Declaration of Susan Benz, July 3, 2014, ¶ 14.

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54. Craig Packer, former head of the Leveraged Finance Business Unit in IBD, similarly explained in 2014 that tasks in IBD are often team-oriented, and that profits are measured after months or even years of work on a deal:

> "In IBD, for example, it can take months or years for our work to result in revenues. In Securities, trades are consummated relatively quickly usually within minutes or hours. In addition, revenue generation in Securities is more easily attributable to individuals than it is in IBD, and as a junior banker in IBD, it is difficult to be the primary driver of revenues. While professionals in Securities tend to be more individually focused and their individual contributions are relatively easy to determine, IBD is highly team oriented, and an individual banker's contribution may not always be obvious."[46]

55. As the declarations indicate, the primary driver of revenue, and therefore bonuses, varies across the three divisions. IBD revenues are a function of global deal volume. Specifically, the more transactions that occur, the better the investment banking industry will do, all else being equal.[47] In IMD, revenues are often related to the value of assets under supervision (AUS).[48] Therefore, an investment manager with more favorable investment performance will make more money than one with worse investment performance, all else being equal.[49] Finally, Securities revenues are tied to trading volumes and sales across a wide range of financial products and instruments. The more trading that GS facilitates for its clients, the more money it will make, all else being equal.[50]

56. The record indicates that differences in how divisions make and measure profits can lead to differences across divisions in how pay and promotion are determined. As explained by Ms. Benz in 2014, this is reflected in the focus on personal experience or seniority for determining pay in Investment Banking, as opposed to the focus on individual profits in Securities:

> "In terms of compensation and promotion, the length of an individual's tenure is generally more important in IBD ███████████████████

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[46] Declaration of Craig Packer, July 2, 2014, ¶ 6.

[47] See, e.g., Goldman Sachs Group, Inc., SEC Form 10-K for period ended December 31, 2018 ("Goldman Sachs Form 10-K, 2018"), p. 56.

[48] See, e.g., Goldman Sachs Form 10-K, 2018, pp. 61–62.

[49] See, e.g., "Investment Management Division Compensation Guidelines: Compensation Managers," October 2017, GS0375564 – 89 at GS0375568 and GS0375570.

[50] See, e.g., Goldman Sachs Form 10-K, 2018, p. 58.

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███████████████████████████

███████████████████████████████

████████████████ ."[51]

57. These examples of job differences imply that each division also uses different measures of productivity to evaluate a professional's contributions. This is an important example of how different business objectives across divisions result in different evaluation processes and compensation setting for professionals across divisions—a fact that will be important to the statistical analyses in this report.

3.1.3. *Each division consists of many different Business Units*

58. In addition to there being differences in jobs across divisions, declarations and other evidence indicate that there are also a variety of jobs within each division. Each division is comprised of numerous Business Units.[52] In Exhibit 12, I highlight the number of Business Units within each division at GS. As of 2018, there were 32 Business Units in Securities, 24 in Investment Banking, and 23 in Investment Management.

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[51] Declaration of Susan Benz, July 3, 2014, ¶ 15.

[52] Throughout my report, I identify Business Units in the data based on information from division-level files and augmented by PeopleSoft data, in accordance with the Declaration of Jacqueline Cassidy, October 19, 2020, ¶ 2; Declaration of Kathleen Cupertino, November 12, 2020, ¶ 3; and Declaration of Joanna Kozlowski, November 28, 2020, ¶ 2. This allows me to identify Business Units that correspond as closely as possible to the unit within which manager quartiling and compensation decisions are typically made, as well as the unit at which compensation budgets are set. See Section 3.3 for a discussion of decision makers.

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Exhibit 12

There are many Business Units within Goldman Sachs: 2018

Source: Goldman Sachs Data Production

Note: Figure shows Business Units with at least one relevant professional in 2018. The sample consists of Associates and Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC. As of 2018, there were 32 Business Units in Securities, 24 in Investment Banking, and 23 in Investment Management.

59. These different Business Units require professionals with different skills and different expertise to support their different business interests. These Business Units are also the level at which divisional leadership allocates annual divisional compensation budgets (see Section 3.2.4). In addition (as I detail below in Section 3.2.2) manager quartiling is often conducted by Business Unit heads. As a result, Business Units are important decision-making units for performance evaluation and compensation setting. Declarations from numerous GS leaders in 2014 indicate that **professionals across different Business Units have distinct roles and jobs**:

- In the **Securities** division in 2014, for example, traders in the Goldman Sachs Electronic Trading Business Unit were expected to possess technical skills and deep knowledge of equity markets, all while working with clients to execute trades and provide advice.[53] Professionals in the

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[53] Declaration of Todd Lopez, July 1, 2014, ¶ 5 ("Each electronic sales trader covers a specific group of clients and serves as a contact to provide execution and trading insights for those clients. These individuals are expected to

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Principal Strategic Investment Business Unit, on the other hand, investigated and made investments in technologies and companies that could improve the overall infrastructure of the Securities Division and helped streamline the work of professionals in other Business Units.[54]

- In **IMD** in 2014, professionals in the U.S. Third Party Business Unit worked with financial intermediaries (like banks or insurance companies) in order to organize the resale of Goldman Sachs investment products from the intermediary to investors.[55] Within Private Wealth Management, on the other hand, professionals worked directly with individual clients and helped to create personalized investment plans.[56]

- In **IBD** in 2014, professionals in the Equity Capital Markets Business Unit were expected to have a holistic understanding of human psychology to value properties like the Empire State Building, whereas professionals in Structured Finance were expected to have a technical understanding of complex financial instruments.[57]

60. It is clear from the record that an individual in the Securities division responsible for structuring financial instruments has a distinct job from someone whose job is to evaluate the value of the Empire State building. The

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have a high degree of technical aptitude because of the electronic nature of the business. They must also understand equity market microstructure (i.e., where clients can access liquidity).").

[54] Declaration of Darren Cohen, July 1, 2014, ¶¶ 6–7 ("Individuals in my Business Unit work with specific desks across the Securities Division to understand which potential investments would generate attractive investment returns while also enhancing the value of our sales and trading franchise. ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮ Above all else, there must be both strategic and financial rationales for any decision that we make, meaning that our investments should (1) improve the Securities Division infrastructure; and (2) prove a sound investment for the Firm.").

[55] Declaration of James McNamara, June 30, 2014, ¶ 4 ("In a nutshell, the U.S. Third Party Business Unit targets individuals through financial intermediaries including regional broker-dealers, banks, insurance companies, and Registered Investment Advisors ('RIAs'). These 'third parties' in turn make GSAM products available to retail and institutional investors through a wide variety of investment vehicles including mutual funds, separate accounts, and alternative products. ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮

[56] Declaration of Megan Taylor, June 30, 2014, ¶¶ 5–6 ("Sales professionals in PWM generally serve one of three distinct roles: (1) Private Wealth Advisors ('PWAs'); (2) Wealth Management Professionals ('WMPs'); and (3) Financial Investment Professionals ('FIPs'). PWAs, WMPs, and FIPs generally work together in teams to service specific clients. These teams are led by PWAs, who work directly with clients to help develop financial plans and investment management strategies, and identify investment opportunities so that clients successfully meet their individualized goals and objectives.").

[57] Declaration of Stephen Pierce, July 2, 2014, ¶ 7 ("As an example, ECM recently worked on the IPO of the Empire State Building. Among other things, the team had to determine whether an offering of an iconic American building would be successful in Europe, or in Asia, and how investors would value the observatory at the top of the building. While financial analysis and modeling can help answer such questions, a key piece of the assessment involves a general understanding of market dynamics and human psychology. In this way, ECM differs from more technical groups in Financing, like Structured Finance, which deals with the technical structuring of esoteric products. In general, Structured Finance is thus closer to a 'science' than is ECM, which tends to draw on both 'art' and 'science.'").

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implication is that in order to properly account for the variables that affect an individual's pay (or performance, or promotion) one must take differences in job duties across business units into account.

61. **Furthermore, compensation differs across Business Units due to differences in Business Unit revenue.** Using IBD as an example: GS's investment bank is composed of many Business Units, with coverage areas often defined by geography and industry. Some Business Units are "stronger" than others, meaning that GS has particularly strong expertise and relationships in certain coverage areas, giving bankers on those teams an edge when it comes to generating revenues and bonuses relative to their peers in "weaker" Business Units, all else being equal. The exhibit below, which was published as part of GS's January 2020 Investor Day presentation, shows that although GS, as measured by league table ranking,[58] is generally a very strong competitor in M&A advisory, some Business Units are ranked better than others (1 vs. 2).[59] In addition, there is variation across subgroups inside the TMT Business Unit (Tech, Media and Telecom), a point to which I return in the next section regarding the diversity of jobs *within* a given business unit.

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[58] A league table is a ranking of investment banks based on a set of criteria, such as revenue, earnings, deals, or any other relevant metrics.

[59] Goldman Sachs, "Goldman Sachs Investor Day," January 29, 2020, p. 92, available at https://www.goldmansachs.com/investor-relations/investor-day-2020/presentations/consolidated-presentations.pdf, accessed on February 25, 2021.

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Exhibit 13
Goldman Sachs League Table Rankings for M&A

Announced M&A League Table Ranking[1]
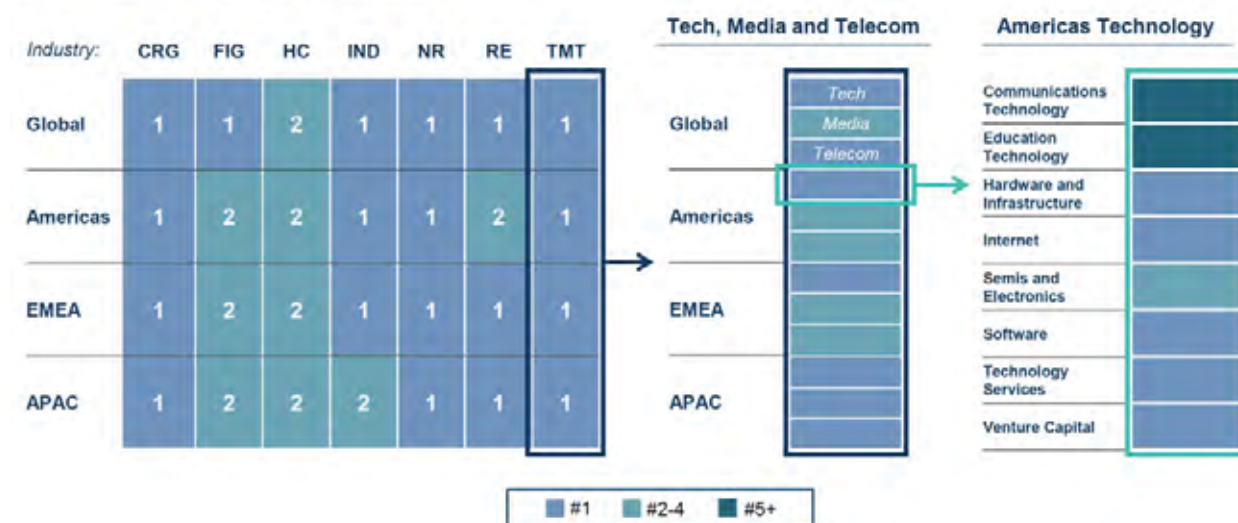
Source: Goldman Sachs January 2020 Investor Day Presentation

Note: According to the presentation, the data are from Dealogic from 2015–2019, "based on target industry using Goldman Sachs internal industry classifications. CRG = Consumer and Retail, FIG = Financial Institutions, HC = Healthcare, IND = Industrials, NR = Natural Resources, RE = Real Estate and TMT = Technology, Media and Telecom."

62. Performance across Business Units will also depend on factors specific to their respective areas and industries of coverage. For example, one would expect revenues and bonuses for the Natural Resources business unit in IBD to move with prevailing commodity prices, such as when upstream oil and gas (i.e., exploration and production) M&A activity declined precipitously in 2015 in the wake of a collapse in global oil prices.[60] In addition, performance can vary considerably across Business Units within the same year. For example, while I just noted that 2015 was a lean period for oil and gas investment bankers, it proved to be a big year for pharmaceutical investment bankers.[61]

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[60] Bryan Collins, "Energy 2018 Upstream M&A Impelled By Quest For Oil-Rich, Contiguous Shale Footprints," _S&P Global_, December 13, 2018, available at https://www.spglobal.com/marketintelligence/en/news-insights/research/2018-upstream-ma-impelled-by-quest-for-oil-rich-contiguous-shale-footprints, accessed on February 25, 2021. See also Deloitte Center for Energy Solutions, "Oil & Gas Mergers and Acquisitions Report – Year-end 2015: Waiting for a rebound," available at https://www2.deloitte.com/content/dam/Deloitte/ru/Documents/energy-resources/er-og-ma-year-end-2015-repor.pdf, accessed on March 11, 2021.

[61] See exhibit in Jan Ascher, Roerich Bansal, Ajay Dhankhar, and Edward Kim, "A new prescription for M&A in pharma," _McKinsey & Company_, September 10, 2020 available at https://www.mckinsey.com/business-functions/m-and-a/our-insights/a-new-prescription-for-m-and-a-in-pharma, accessed February 25, 2021. See also Joanne Finnegan, "2015 Was a Record Breaker for M&A in Pharma, Medical and Biotech with Deals Worth $575 Billion," January 14, 2016, available at https://www.biospace.com/article/releases/2015-was-a-record-breaker-for-m-and-a-in-pharma-medical-and-biotech-with-deals-worth-575-billion-/, accessed on March 11, 2021.

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63. In addition, virtually all of GS's business has evolved considerably since 2003. The most significant event during this period was the Global Financial Crisis ("GFC"), which began in late 2007, lasted into 2009, and changed the financial industry in important and irrevocable ways. Different Business Units were differentially exposed to the forces of the GFC and its aftermath—including increased regulatory scrutiny in certain segments—and, as a result, some expanded, some contracted, and some were dissolved. A good example of restructuring at GS related to the GFC was the firm's decision to scale back its proprietary trading operations in the wake of the crisis.[62] These groups, which invest in asset-related instruments using GS's own money, drew considerable scrutiny from regulators and were restricted by the Dodd-Frank act after the crisis. Similarly, GS's Reinsurance Business Unit was sold in 2013 following an increase in capital requirements for operating this business.[63]

64. As this history illustrates, the set of Business Units within a division changes over time. This reflects changes in GS's business structure and objectives during the relevant period, and, thus, actual changes in the units for which budgets are set and within which decisions are made within a division. These changes need to be accounted for when analyzing GS processes. It is common for large firms like GS to implement organizational changes in response to changes in business opportunities or other conditions in the marketplace.

65. Prof. Farber argues that because Business Units change over time, it may not be appropriate to include Business Units in an analysis of compensation.[64]

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[62] Matthias Rieker, "Goldman to Close Prop-Trading Unit," *Wall Street Journal*, September 4, 2010, available at https://www.wsj.com/articles/SB10001424052748703946504575469952837595726, accessed on March 6, 2021; Financial Post, "Goldman Sachs closing fixed-income prop desk: source," February 26, 2011, available at https://financialpost.com/investing/goldman-sachs-closing-fixed-income-prop-desk-source, accessed on February 25, 2021.

[63] Jessica Toonkel, "Goldman looks to sell major stake in reinsurance group," Reuters, January 16, 2013, available at https://www.reuters.com/article/us-goldman-reinsurance/goldman-looks-to-sell-major-stake-in-reinsurance-group-idUKBRE90F0XO20130116, accessed on March 10, 2021; Goldman Sachs Press Release, "Goldman Sachs Completes Global Atlantic Investment Offering," May 1, 2013, available at https://www.goldmansachs.com/media-relations/press-releases/archived/2013/gs-completes-global-atlantic-investment-offering.html, accessed on March 10, 2021.

[64] Farber Report, footnote 4 ("As described in my Class Certification Rebuttal Report, it may be inappropriate to include Business Units in my pay analyses. The reasons for this decision were that Business Unit assignments are within Goldman Sachs' control and thus are a potentially tainted variable (Farber Rebuttal Report, January 28, 2014 at ¶ 113), and that Business Units and the populations that work within them are unstable (Farber Rebuttal Report, January 28, 2014 at ¶ 114). In addition, Goldman did not provide a way to identify Business Units in two divisions prior to 2004, so it is not possible to estimate a model with Business Unit for all relevant years. However, I have seen some documentary support that Business Units are a locus of decision-making in regards to compensation decisions (see fn 67, below). I have performed versions of many of the compensation analyses in my report that include Business Unit controls (where appropriate), and find that the inclusion of Business Unit as a control variable makes no qualitative difference to my conclusions. Because Business Unit data are not available for the entire time period, I do not estimate damages using a model that includes Business Units.").

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This argument does not make economic sense. The fact that GS's business objectives and activities have evolved over time does not mean that Business Units are somehow "unreliable" units to analyze. In fact, the opposite is true. Given that the class period in this case extends over a long time period, and given that GS's business has evolved during that time (including navigating the financial crisis), it is absolutely critical to account for Business Units when analyzing compensation decisions. In addition, one can "interact" the variable for each Business Unit with variables for year, allowing the effect of Business Unit on compensation to vary over time.

66. In conclusion, Business Units are a critical organizational feature at GS. These different Business Units require professionals with different skills and different expertise to support their different business interests. Given differences in the underlying activity of its Business Units, each division within GS uses different measures of productivity to evaluate a professional's contributions. Compensation also differs across Business Units due to differences in Business Unit revenue, as the compensation budgets allocated to Business Units depend on their financial performance. Thus, it is important to account for Business Units when analyzing the challenged processes and compensation setting.

3.1.4. *Even within a Business Unit, there are variety of jobs*

67. Although Business Units are helpful as a classification, the reality is that Business Units are not monolithic. There can exist considerable heterogeneity in "jobs" within a Business Unit. In labor economics, it is standard to think about a "job" as a collection of tasks and responsibilities that a person performs.[65] Different jobs represent different collections of tasks; and people who conduct different tasks are said to have different jobs. The concept of a "job" is fundamentally different from a corporate title or an organizational unit like a division or Business Unit. Even within Business Units, the record reveals a great deal of variation in the types of jobs that

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[65] Edward P. Lazear and Michael Gibbs, *Personnel Economics in Practice*, Third Edition, (John Wiley & Sons, Inc, 2015), p. 158 ("First, two important features of job design are the amount of decisions and tasks that the employee performs."). See also David H. Autor and Michael J. Handel, "Putting Tasks to the Test: Human Capital, Job Tasks, and Wages," *Journal of Labor Economics*, 31(2), 2013, pp. S59–S96 at p. S60 ("Recent literature attempts to supply this conceptual apparatus by using a 'task framework' to analyze job skill requirements (Autor, Levy, and Murnane 2003). The simple idea of this approach is to classify jobs according to their core task requirements–that is, the main activities that workers must accomplish in their work–and then consider the set of formal and informal skills required to carry out these tasks."); Daron Acemoglu and David Autor, "Skills, Tasks and Technologies: Implications for Employment and Earnings," in *Handbook of Labor Economics*, Volume 4b, ed. Orley Ashenfelter and David Card (Elsevier B.V., 2011), pp. 1043–1171 at p. 1045 ("A task is a unit of work activity that produces output (goods and services). In contrast, a skill is a worker's endowment of capabilities for performing various tasks. Workers apply their skill endowments to tasks in exchange for wages, and skills applied to tasks produce output.").

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professionals perform, including professionals with the same corporate title (Associate or VP). Within Business Units, team members may have duties and roles that are, for example, more or less technical or more or less client-facing. These jobs differ in the type of work performed, the type of experience required, and the type of compensation earned.

68. For example, Donald Casturo, Global Chief Operating Officer of the Commodities Sales Business Unit in **Securities** in 2014, explained that those with the corporate job title of Corporate Sales Representative are expected to have specific knowledge about a given commodity (like gold or coal), and are often hired from the relevant industry (such as a geologist for coal securities). In contrast, those with the corporate job title of Institutional Sales Representative within the same Business Unit are generalists, and are required to have broad financial knowledge in order to work with institutional clients on a portfolio that spans the broader commodities market.[66]

69. Within the Private Wealth Management Business Unit in **IMD**, Megan Taylor, the Global Chief Operating Officer of Private Wealth Management in 2014, explained that professionals who are Financial Investment Professionals are responsible for marketing and high-level strategic issues, while Wealth Management Professionals provide day-to-day technical support to clients.[67]

70. In the Leveraged Finance Business Unit within **IBD**, Originators are responsible for structuring and executing financial transactions, and must have a high level of technical expertise.[68] Within the same Business Unit, members

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[66] Declaration of Donald Casturo, June 27, 2014, ¶¶ 7–8 ("Due to their specialized concentrations, corporate sales representatives require specific knowledge regarding their underlying commodities and the relevant industry; there are specific considerations germane to each area. To this end, we hire many corporate sales representatives from industry jobs; they often worked for companies that produced or consumed the relevant commodities prior to coming to Goldman Sachs. For example, our sales representative focusing on coal is a geologist and an engineer by training. ... Unlike the many industry specialists in corporate sales, institutional sales representatives are better characterized as 'generalists' and work with sophisticated investors regarding not one type, but a wide array of commodities. Rather than focusing on risk-mitigation, institutional sales representatives primarily work with traders to assist their clients in how to most efficiently invest across wider sectors of the commodity market. Whereas corporate sales representatives may be experts in a specific commodity, institutional sales representatives focus on broader client portfolio objectives and propose trades to achieve those goals. In so doing, they follow various markets and analyze global supply and demand.").

[67] Declaration of Megan Taylor, June 30, 2014, ¶ 8 ("Unlike FIPs, who work with the PWAs on marketing and other higher-level strategic issues, WMPs typically provide more technical support for day-to-day client services.").

[68] Declaration of Craig Packer, July 2, 2014, ¶ 10 ("Originators are responsible for sourcing, structuring and executing the transactions. This role involves financial analysis and modeling; credit analysis; negotiation of commitment papers, indentures, and credit agreements; industry research; and preparation of offering documents. To be successful, originators must have technical expertise in the financial products that they offer, must be extremely knowledgeable about market conditions, and must excel at credit analysis.")

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of the Syndicate Desk are responsible for pitching and distributing financial products and are expected to exhibit strong risk judgment.[69]

3.1.5. *Variables in available data help delineate the different jobs and different measures of productivity across and within Business Units*

71. Given the point that there are many different jobs in Securities, IMD, and IBD, it is important to measure differences in jobs in the regression analyses that follow in this report. As noted above, data produced in this case contain variables that help delineate the different jobs assigned to professionals at GS, in addition to the two corporate titles for class members of Associate or Vice President.[70] As also noted above, the data delineate which Business Unit a professional works in. Additionally, within the available data produced in this matter, GS also tracks information on "function" for IMD and Securities (but not IBD) that helps delineate some of the different jobs that can exist even within a Business Unit.[71] For example:

- In the Global ISG Business Unit in IMD, class members and their male counterparts were classified as fulfilling five functions in 2018: Portfolio Advisory Group, Portfolio Manager, Strategic Asset Allocation, Tactical Asset Allocation, and Wealth Management Professional.[72]

- In the Prime Services Business Unit in Securities, class members and their male counterparts fulfill one of three functions in 2018: Sales, Securities Services, and Trading.[73]

72. Other job-related variables in GS's data include "department" and "desk." Departments are sub-groups within Business Units in each of the three divisions, and desks are similar organizational units in Securities.[74] As I will

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[69] Declaration of Craig Packer, July 2, 2014, ¶ 11 ("Professionals on the Syndicate Desk are responsible for distributing and syndicating the financial product, and working with the sales force at the Firm to sell the product to investors. The Syndicate Desk makes critical judgments about the marketing, pricing, and distribution of Leveraged Finance products. Since the Firm often provides its own capital for these deals, Syndicate Desk bankers must have extremely strong risk judgment, ██████████████████████████, as well as an exhaustive knowledge of the relevant financial market, including a keen understanding of investor appetite for a particular product.")

[70] As discussed above, within IBD, Associates through second-year VPs are classified as "Junior Bankers," whereas third-year VPs and beyond are referred to as "Senior Bankers."

[71] In Securities, I standardize "function" information from a number of different fields in the produced data.

[72] Workpaper 4.

[73] Workpaper 4.

[74] See, e.g., Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 124 ("Q. How are those meetings for the larger Business Units divided up into groups, is it by desk or – not desk, or is it by subunit or – A. By desk or

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discuss, the fact that many departments and desks comprise only a few individuals limits my ability to use these fields in my regression model of compensation.[75] Importantly, however, the sizable number of departments and desks highlights the wide range of jobs that comprise each Business Unit.

73. The produced data in this case also include Affirmative Action ("AA") job groups, which Prof. Farber inappropriately includes in his models. These are aggregated job groupings constructed for a specific regulatory purpose, and I have seen no evidence that GS uses them to delineate jobs in the ordinary course of business. AA job groups combine professionals in different functions, Business Units, and even divisions; but in fact, these professionals each have distinct job duties and are compensated differently.[76] For example, in 2014, the "Senior Finance Associates" AA job group accounted for a full 50 percent of class-relevant professionals, spanning all three divisions, 56 Business Units, and 58 functions.[77] As a result, AA job group is an entirely inadequate job measure, and I exclude it from all of my regression models accordingly.

74. There are also different measures of productivity across divisions and Business Units. The available productivity data can be used to help delineate the different skills that are valued across jobs within the firm. The data track a variety of different variables that different divisions use to measure productivity, as well as variables that different Business Units within a division use to measure productivity.

- In **IBD**, GS data contain information on the total revenue generated across all projects within a given year, and whether a Senior Banker held the role of client representative.

- In **IMD**, GS data contain information on "Alpha and Risk" and "Investment Culture" scores for professionals in certain jobs. The Alpha and Risk score measures a professional's contributions to the performance and risk management of investment portfolios, and the Investment Culture score is based on the manager's evaluation of qualitative aspects of the professional's performance. These scores are

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department or subunit, it would depend what made sense for that particular business. But exactly how you described a subunit or desk would be a department.").

[75] See footnote 89.

[76] See Workpaper 5.

[77] See Workpaper 5; "2012-2018 aa_job_SENSITIVE_CONFIDENTIAL_DATA.xlsx".

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also combined into a single "Investment Composite Score."[78] The data also include information on the gross sales of long-term fee-based ("LTFB") assets for certain professionals.

- In **Securities**, GS data record the actual financial contribution of each professional within a given year. Contributions are defined differently for professionals with different functions. For example, for traders, contributions are measured by profits and losses ("P&L"); for salespeople, production refers to sales credits.[79]

75.   However, as discussed further in Section 6.3, these measures are not available for all professionals, and do not fully reflect all professionals' production, and therefore do not fully capture differences in professionals' productivity.

3.1.6. *Variation in compensation within and across Business Units and functions further confirms variation in jobs, skills, and productivity*

76. In this section, my goal is to use the distributions of professionals' compensation data to show that within GS, there is substantial diversity in jobs (or job duties) and productivity across and within divisions, Business Units, and functions even within the same year. Within a large firm such as GS, there will be a formal pay structure, such that people doing the same job in the same year will have the same basic compensation structure—e.g., a base salary and a bonus. But that formal pay structure allows for wide variation in pay. Indeed, documents indicate that GS's compensation "philosophy" is that "████████

██

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██

████████████████[80] As this makes clear, when people are doing very different jobs,

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[78] Goldman Sachs – IMD Production Data__SENSITIVE_CONFIDENTIAL_DATA.xlsx, Tab "2014_ICE" ("(1) Alpha and Risk scores reflect both historical contribution to risk-adjusted excess returns, as well as managers' evaluation of impact on research (future alpha), and investment risk management (100% = best, 0% = worst). (2) Investment Culture includes managers' evaluation of broader contributions to the quality of investment services we provide our clients, including accuracy in execution, efficient use of team resources, clients support, effective management of operational risk and compliance (100% = best, 0% = worst). (3) Investment Composite Score Percentile Rank incorporates Alpha and Risk, and Investment Culture. Scores are weighted to reflect business unit priorities: the relative importance of a characteristic change across functions, over time and across different business units. Scores are percentile ranked within the relevant business unit (100% = best, 0% = worst).").

[79] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 78 ("So, for traders, production would refer to their P&L and for salespeople it would refer to sales credits.").

[80] See e.g., "2008 Detailed Compensation Communication Guide for HCM," 2008, GS0274507 – 31 at GS0274512; See also, e.g., "2017 Manager Compensation Communication Guide," 2018, GS0375666 – 77 at GS0375668.

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the pay range will vary across the job roles.[81] Additionally, even within a job, the pay range can vary substantially across individuals based on differences in productivity in that year. Indeed, bonuses account for a large share of total compensation for many professionals at GS.[82]

77. A widely accepted tenet of labor economics is that key drivers of compensation are (a) the specific skills and experience of each worker, (b) the overall value of those skills and experience to the firm's business, and (c) a worker's productivity.[83] Given these facts, it is common in labor economics to analyze differences in compensation as a way to assess the extent of differences in the underlying skills, productivity, and roles of workers.[84] Compensation data produced by GS helps highlight the diversity in jobs, skills, and productivity that exist across divisions, Business Units, and functions. The available data show large variation in compensation across professionals, which is consistent with the fact that GS's internal labor market contains of a wide variety of jobs, skills, and productivity. As I will discuss in more detail below any analysis of the challenged processes must take this variety of jobs, skills, and productivity into account.

78. GS databases contain information on each professional's Per Annum Total Compensation ("PATC"). GS's PATC variable reflects total pay (including salary and bonus) and is annualized when a professional only worked part of a given year. In Exhibit 14, I show that different Business Units have different average PATC.[85] For example, for Senior Bankers in IBD, the average pay in the M&A Group is about $540,000, while the average pay in the Real Estate group is over $750,000.[86] Further, even within a Business Unit, there is large variation in individual compensation. For example, in the RE Financing Business Unit,

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[81] See discussion of job analysis/evaluation and compensation setting in Kevin F. Hallock, "What's in a Job: Job Analysis, Job Evaluation, and Internal Comparisons" and "Matching the Internal Organizational Structure to the Right Market Data: How and How Much to Pay," *Pay: Why People Earn What They Earn*, (New York City, NY: Cambridge University Press, 2012), pp. 61–83. See also David H. Autor and Michael J. Handel, "Putting Tasks to the Test: Human Capital, Job Tasks, and Wages," *Journal of Labor Economics*, 31(2), 2013, pp. S59–S96 at p. S62 ("We present evidence below both that job tasks differ among workers within an occupation and that this variation is an important determinant of earnings.").

[82] See, e.g., "Historical Salary Summary," 2012, GS0113480 – 2 at GS0113481.

[83] See, e.g., Daron Acemoglu and David Autor, "Skills, Tasks and Technologies: Implications for Employment and Earnings," in *Handbook of Labor Economics*, Volume 4b, ed. Orley Ashenfelter and David Card (Elsevier B.V., 2011), pp. 1043–1171.

[84] See, e.g., Daron Acemoglu and David Autor, "Skills, Tasks and Technologies: Implications for Employment and Earnings," in *Handbook of Labor Economics*, Volume 4b, ed. Orley Ashenfelter and David Card (Elsevier B.V., 2011), pp. 1043–1171.

[85] I present results for other titles and divisions in the backup to this exhibit.

[86] See backup to Exhibit 14 for precise figures.

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about 25 percent of Senior Bankers make *less* than $420,000 while 25 percent
of Senior Bankers make *more* than $875,000.

79. There are two important implications of this large variation in
compensation across Business Units. First, it further confirms that the jobs
performed and skills required differ substantially across Business Units.
Second, is it is crucial to take into account Business Units when building a
regression model that seeks to understand why some individuals are paid more
or less than others.

Exhibit 14
Compensation varies widely across and within Business Units

Senior Bankers in Investment Banking, 2018
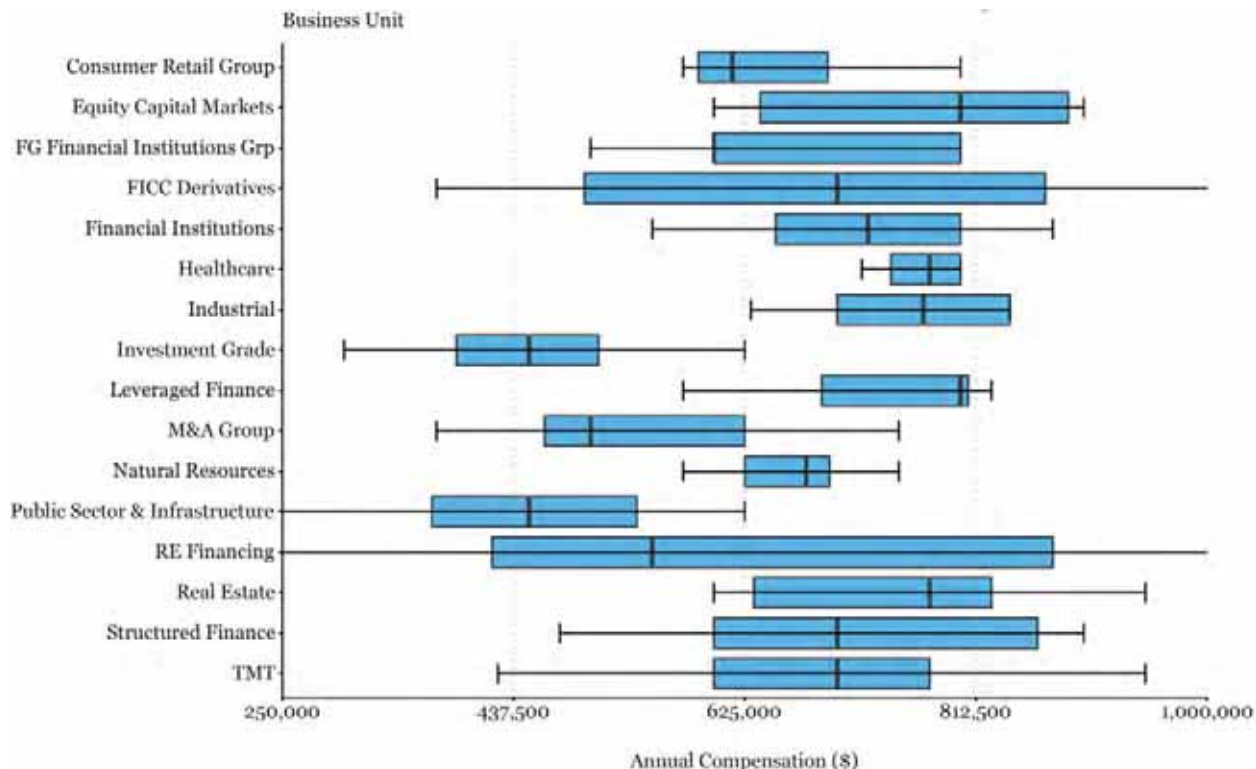
Source: Goldman Sachs Data Production

Note: The sample consists of Senior Bankers in Investment Banking as of the end of the fiscal year who had non-missing PATC. The box plots display the interquartile range ("IQR"), the 25th to 75th percentiles of annual compensation, for each Business Unit. The vertical band within each box is the median annual compensation. The whisker to the right of each box extends to the maximum annual compensation that is within 1.5*IQR of the 75th percentile. The whisker to the left of each box extends to the minimum annual compensation that is within 1.5*IQR of the 25th percentile. Business Units with fewer than five professionals have been excluded for clarity. The sample includes 177 professionals in 16 Business Units. Professionals with annual compensation that is less than $250,000 or greater than $1,000,000 or outside the range covered by the whiskers are not shown for clarity.

80. In Exhibit 15, I emphasize that professionals with different functions within
a division also have very different average PATC, and that even within a

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function, there is large variation in individual compensation.[87] As noted above, I have comprehensive data on professionals' functions for IMD and Securities, but not for IBD. Function helps capture some of the different types of jobs within a division (and even a Business Unit).

81. For example, two functions in IMD depicted in the exhibit are "regional sales manager" and "portfolio manager." The median PATC for VP regional sales managers is around $850,000, whereas the median PATC for VP portfolio managers is less than $300,000.[88] Two functions in Securities are "trading" and "strategist." The median PATC for VP traders is around $700,000, while the median PATC for VP strategists is $350,000. These large differences in compensation are, again, evidence that there are large and meaningful differences in the jobs performed across functions. Thus, in order to model the compensation of an individual one needs to consider his or her function, in addition to his or her business unit.

82. Finally, note that even within a given function, PATC varies widely. For example, in IMD, professionals labeled "External Wholesaler" have PATC spanning from less than $250,000 to more than $1,000,000. This suggests there are even finer gradations of "jobs" within a given function title, and that the available data do not capture these distinctions.

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[87] I present results for other titles and divisions in the backup to this exhibit.

[88] See backup to Exhibit 15 for precise figures.

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Exhibit 15

Compensation varies widely across and within functions

Vice Presidents in Investment Management, 2018
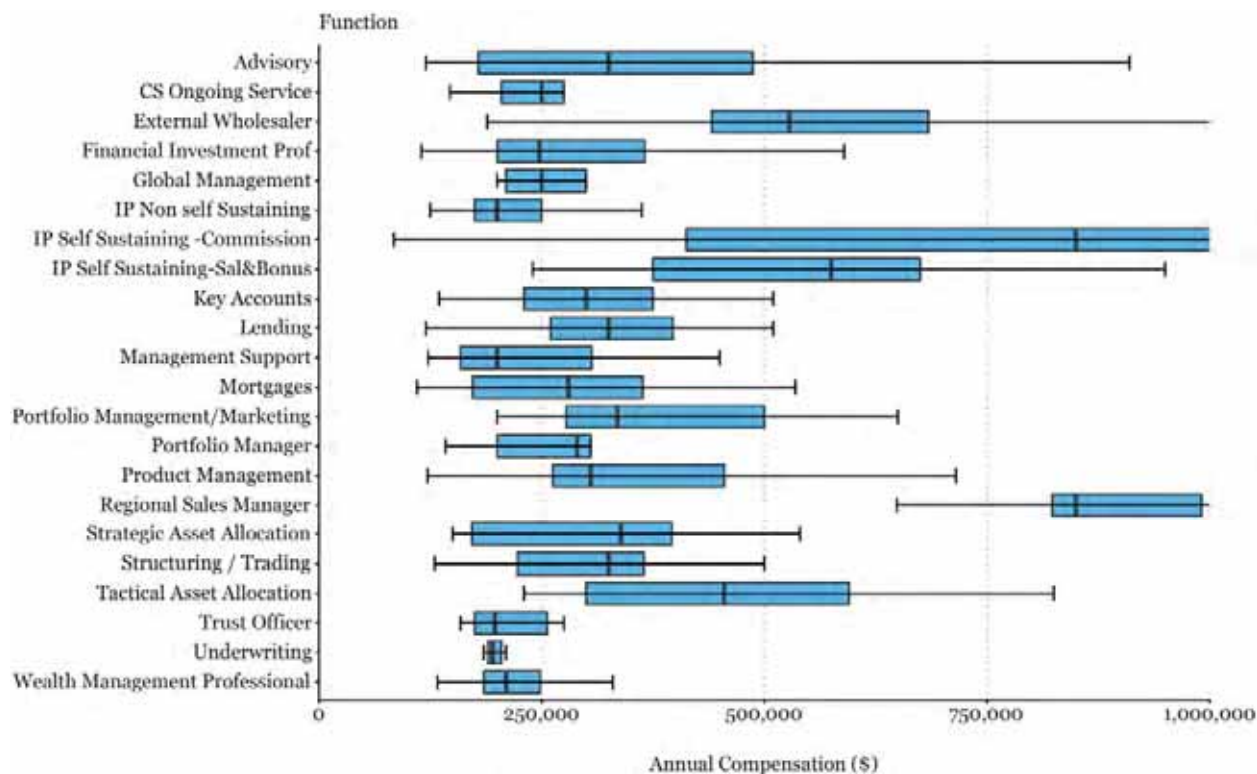
Source: Goldman Sachs Data Production

Note: The sample consists of Vice Presidents in Investment Management as of the end of the fiscal year who had non-missing PATC. The box plots display the interquartile range ("IQR"), the 25th to 75th percentiles of annual compensation, for each function. The vertical band within each box is the median annual compensation. The whisker to the right of each box extends to the maximum annual compensation that is within 1.5*IQR of the 75th percentile. The whisker to the left of each box extends to the minimum annual compensation that is within 1.5*IQR of the 25th percentile. Functions with fewer than five professionals have been excluded for clarity. IP Self Sustaining - Commission function has median compensation of $849,968 and 3rd quartile compensation of $1,435,041. Office Management - RH function has 1 professional with a compensation of $1,300,000. The sample includes 784 professionals in 22 functions. Professionals with annual compensation that is greater than $1,000,000 or outside the range covered by the whiskers are not shown for clarity.

83. In summary, I show that there are large differences in compensation (a) across Business Units, (b) within Business Units, (c) across functions, and (d) even within functions for both Associates and VPs, consistent with variation in jobs, skills, and productivity across and within these groups. In light of these facts about GS, when analyzing any alleged gender gaps it is critical to account for (at a minimum) the different Business Units, functions, and levels of productivity that are available in the data, and that are considered by managers when making decisions about review scores, compensation, and promotion.

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3.1.7. Conclusion: Heterogeneity across GS's organizational structure has implications for statistical modeling

84. Considerable heterogeneity in jobs, production, and compensation exists across GS's organizational structure. These differences have two important implications for the statistical analyses in the remainder of this report.

85. First, the fact that there is such a wide variety of jobs across divisions, Business Units, and functions—and that professionals in those roles are evaluated in different ways and have substantially different levels of compensation—means that controlling for differences in jobs and production will be critical to any statistical model of the challenged processes or compensation. As I will explain in Section 4, by correctly incorporating these variables into my regression models, I am able to empirically test whether GS's performance evaluation processes, promotion process, and compensation setting suffered from common bias. And as I will demonstrate in Section 6 below, Business Unit, function, and production are particularly important variables in understanding why compensation varies across professionals.

86. Second, based on testimony from GS leaders and GS's compensation data, even within a Business Unit and/or function, individuals' jobs and compensation vary substantially, but the evidence also indicates that the available measures for "job" in the GS data do not adequately or completely delineate the many different jobs within GS. This data limitation is important in interpreting the findings in Section 6, when I explain my assessment of Prof. Farber's regression model of compensation and discuss my enriched regression model.

87. Given the measures of job differences that I do have, even my most enriched and comprehensive statistical model of GS's compensation system cannot account for *all* the important differences in job responsibilities across individual professionals that affect compensation.[89] Thus, even after adding my

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[89] As noted above, GS's data also contains job-related variables called "departments" and "desks." These organizational units can be quite small: many of them consist of only a single class-relevant Associate or Vice President. In other words, whatever job responsibilities are captured by these variables are often unique to a single professional at GS. This implies that a statistical model of compensation at GS cannot fully account for job responsibilities. By its nature, a statistical model estimates average gender differences in pay *within* the categories included in the model (holding fixed the other factors in the model). If a category in the model only has a single professional, then there is no measurable gender difference in pay within that category. This means that such a category cannot contribute to the average pay gap estimated by the model. In other words, the professionals in single-employee categories (like a desk or department) are effectively excluded from the analysis. In general, the statistician faces a tradeoff when deciding whether to include a variable with small categories in her model: including the variable allows the model to reflect compensation setting more closely, but it also

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detailed variables that are omitted by Prof. Farber, there can be further omitted variable bias, whereby the alleged gender gap measured by the regression is driven by factors that the regression model cannot account for, rather than by any alleged gender bias in the process being analyzed.

88. As I will explain in detail in Sections 4–6, it is important to consider the extent of omitted variable bias when assessing whether average differences in the review processes and compensation between men and women are *caused* by the challenged processes. In particular, as I will show in Sections 5 and 6 below, the average differences in the review processes and compensation between men and women estimated by my regression analyses vary across different decision-making units within GS, with some gaps in favor of men and others in favor of women. This variability in gender gaps is inconsistent with Plaintiffs claims of systemic bias in GS processes, but is consistent with the average gender difference estimated by my regressions reflecting omitted variables.

3.2. GS's review and promotion processes, as well as its compensation setting, are implemented in a decentralized manner and rely on manager discretion to assess professionals' individual strengths and overall performance

89. I now turn to a detailed discussion of GS's review and promotion processes, with a focus on the processes that the Plaintiffs challenge. In addition, in response to Prof. Farber's report only—i.e., to the extent his opinions regarding compensation are admitted, but not if they are excluded—I also discuss compensation setting at GS, which I understand is not a challenged process.

90. The description of the processes in Section 3.2 has two aims. First, any statistical analysis of the challenged processes needs to reflect the ways in which these processes are conducted.[90] Second, these descriptions show that each challenged process (and compensation setting) is conducted in a very decentralized fashion, both because of the organizational structure of GS, but also because of the number of decision makers involved in each challenged

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reduces the number of professionals included in the analysis. Because of this tradeoff, I do not include department or desk. More broadly, the tradeoff highlights the inherent limitations of statistical analysis in the presence of highly individualized processes such as compensation setting at GS.

[90] James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Third Edition Update, (Pearson, 2015), p. 236 ("Our approach to the challenge of potential omitted variable bias is twofold. First, a core or base set of regressors should be chosen using a combination of expert judgment, economic theory, and knowledge of how the data were collected; the regression using this base set of regressors is sometimes referred to as a base specification. This base specification should contain the variables of primary interest and the control variables suggested by expert judgment and economic theory.").

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process. Though the Human Capital Management group at GS provides general rubrics or goals, the processes are implemented in a highly decentralized fashion to reflect the different goals of each function or Business Unit, and also to allow for input from many professionals when making decisions. As I explain at the end of this section, properly accounting for how these processes are implemented is critical to conducting an accurate and reliable statistical analysis of Plaintiffs' claim that the challenged processes are biased against female professionals and that this bias led to gender disparities in compensation. Prof. Farber never studied this facet of his assignment, which is one of the reasons his conclusions are neither reliable nor relevant.

91. Because GS's divisions and Business Units are at once individually complex and collectively heterogeneous, these organizational units drive the performance management processes in a very decentralized manner. Specifically, the primary responsibilities for performing reviews, making promotion decisions, and setting compensation for professionals falls to a broad span of managers, who, by virtue of their position, are well-equipped to implement these processes rigorously and fairly. As I explain below in this section, GS's data show that many different sets of decision makers, across different organizational units in the firm, implemented GS's review and promotion processes, as well as its compensation setting.

92. As I explain at the end of this section, properly accounting for the fact that there are many decision makers is critical to conducting an accurate and reliable statistical analysis of Plaintiffs' claim that the challenged processes are biased against female professionals and that this bias led to gender disparities in compensation.

3.2.1. *Description of the 360 review and the Overall Manager Ratings processes*

93. GS's 360 reviews are designed to help professionals receive feedback about their performance on a variety of competencies from peers, managers, and junior colleagues so that they can improve their performance.[91] The 360 review process is implemented in a decentralized manner so that it collects input from

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[91] Deposition of David Landman, September 5, 2013, p. 17 ("Q. Mr. Landman, can you generally describe what the objective of the 360 review process is at Goldman Sachs? A. The objective of our 360 reviews is to gather feedback from individuals that work with any given employee so that the manager can receive input into both understanding their performance and information to provide them with feedback to help them develop."). Deposition of Caroline Heller Sberloti Vol. II, July 11, 2013, p. 280 ("Q. And the -- and the 360 review includes self evaluation, people more junior and people more senior; is that right? A. Correct."). See also Goldman Sachs' Annual Review Process Rollout, "Feedback360+," Summer 2017, GS0380339 – 53 at GS0380341 and GS0380343.

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the peers and supervisors who have detailed knowledge of the specific job and role of the professional being evaluated.

94. By incorporating the perspectives of many individuals, the 360 reviews and the Overall Manager Ratings seek to capture an accurate and holistic view of each GS professional. Decentralized implementation of a review framework allows GS to maintain performance management practices that are sufficiently flexible in their design so as to be applied across the firm's diverse Business Units.

95. Each year, professionals solicit 6 to 12 reviews from peers, supervisors, and/or junior colleagues, including class members.[92] Thus, each professional's 360 review score is determined by a unique set of reviewers, directly contradicting Plaintiffs' claim there is a common review process. Reviewers submit written feedback on the professional's strengths and areas for development, as well as numerical or categorical scores summarizing different competencies.[93]

96. It is very important for later analysis to make the point that GS's 360 review process has evolved over the course of the class period. The framework for the 360 reviews was updated twice, so throughout my analysis, I treat each period (2003 to 2009, 2010 to 2015, and 2016 to 2018) as having a different framework. This is consistent with Prof. Farber's approach. Below, I provide details on these three 360 review frameworks.

97. **Performance managers.** Across all three frameworks described next, each professional evaluated in the 360 process has a "performance manager," also called a "primary manager" in some documents in the record.[94] For the purposes of this report I will use the term "performance manager" interchangeably with "primary manager." The role of the performance manager is to aggregate and synthesize the 6–12 evaluations that each professional receives from his or her supervisors, peers, and subordinates in the 360 review

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[92] Deposition of Caroline Heller Sberloti Vol. II, p. 268 ("Q: …how many names approximately are the employees supposed to select? A: That's moved around over time, but varied between eight and twelve."); "Feedback360+ Discussion with the Partnership Committee," February 2017, GS0376157 – 69 at GS0376159 (to "Simplify user experience," the process was changed to "[require] six review requests instead of ten."). The majority of class members have reviewed other class members; see Appendix K.

[93] See e.g., "Equities Individual Review Book," 2008, GS0120687 – 709; "Investment Banking Individual Review Book," 2005, GS0120774 – 806; "Fixed Income, Currency and Commodities Individual Review Book," 2008, GS0121480 – 503; "360-Degree Feedback Report," 2011, GS0375110 – 26.

[94] See, e.g., "360-Degree Feedback Report," 2011, GS0375110 – 26 at GS037510; "2017 Annual Feedback Summary," 2017, and GS0382320 – 38 at GS0382320.

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process. Under each framework, the performance manager delivers a summary of these reviews (oral or written) to the professional. As I will explain below, in more recent years (from 2016–2018), the performance manager also delivers the written Manager Summary and assigns the professional's Overall Manager Rating.[95]

98. **360 reviews (2003–2009):** In 2003, Goldman Sachs implemented a review system framework that allowed for the collection of reviews from a diverse group of individuals who worked with each professional.[96] This system remained largely unchanged through 2009. Every year, each employee went through the process, which was comprised of three phases, implemented individually for each professional: (a) selection of reviewers, (b) review writing, and (c) feedback delivery.[97]

- *Selection of reviewers:*[98] Every year, each professional worked with his or her manager to compile a list of potential individuals to review the employee's performance.[99] The number of reviewers varied over time, typically between eight and twelve.[100]

- *Review writing:* Each reviewer assigned the professional a value of 1–5 for each competency category, such as Communication Skills,

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[95] See Declaration of Darren Cohen, May 23, 2018, ¶ 8 ("When I deliver feedback, I now also provide an annual feedback summary to everyone I manage. … Now, professionals receive a written package that includes my overall manager rating of the professional (outstanding, good, or needs improvement), as well as written feedback…"). See also Declaration of David Landman, October 13, 2017, ¶ 11 ("While the culmination of the 360 Feedback process has always been a meeting between the professional and his or her manager, all Vice Presidents and Associates are now provided with written feedback, which includes their manager's overall rating (of outstanding, good, or needs improvement), as well as written feedback…").

[96] Deposition of David Landman, September 5, 2013, pp. 60–61 ("…individuals…enter a list of people they wish to review them…after the list is entered, the manager is responsible for reviewing it…Q: Okay. What happens next? A: After the other step that I described where managers review? People then are asked to provide feedback. Q: And what is the form of that feedback? A: It is typically in the form of ratings and commentary. Q: And, again, has that generally been the process by which performance reviews are conducted at Goldman Sachs from 2003 to the present? A: Yes."); Deposition of Caroline Heller Sberloti Vol. II, July 11, 2013, p. 265 ("The performance review process is run out of the FRS system. Employees are asked to select reviewers and their managers approve their reviewer lists.").

[97] Deposition of David Landman, September 5, 2013, Exhibit P-239 [GS0119399 – 401 at GS0119401] ("There are three phases to the Review Process: Selection of Reviewers and/or Reviewees (division specific), Review Writing (reviewers complete ratings and comments online), Feedback Delivery (face-to-face discussion between manager/mentor and reviewee based on collated reviews information).").

[98] Reviewers were often a combination of the reviewee's manager, and peer, more senior, and less senior employees. See, e.g., GS0375169 – 96 at GS0375172; GS0549598 – 638 at GS0549609.

[99] Deposition of Caroline Heller Sberloti Vol. II, July 11, 2013, p. 265 ("Employees are asked to select reviewers and their managers approve their reviewer lists.").

[100] Deposition of Caroline Heller Sberloti Vol. II, July 11, 2013, p. 268 ("Q: …how many names approximately are the employees supposed to select? A: That's moved around over time, but varied between eight and twelve.").

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Teamwork, and Technical Skills, along with written feedback on the professional's strengths and areas for development.[101]

- *Feedback delivery:* Managers collected the reviews and scheduled a face-to-face discussion with the professional to cover the reviews.[102] Part of the feedback delivered to the employee was an average review score. This average review score was adjusted using an algorithm to moderate differences in rating patterns as a result of (for example) reviewers who are overly harsh/lenient.[103] The manager consolidated the average overall numerical score and written comments, culminating in a Manager Summary document which was then delivered (often just verbally) to the employee.[104]

99. **360 Reviews (2010–2015):** In 2010, Goldman Sachs adjusted the 360 review process in a number of ways.

- First, the rating scale for competencies used by the reviewers changed from 1–5 to a 1–9 scale.[105]

- Second, all professionals received copies of 360 Performance Review Feedback Reports.[106]

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[101] From 2003–2009, professionals were rated on a five-point scale. From 2003–2005 professionals were rated individually on three criteria ("Overall Commercial Effectiveness, Leadership, and Overall Professional Performance") and from 2006–2009 on nine criteria ("Technical Skills, Communication Skills, Judgement/Problem Solving, Teamwork, Compliance, Diversity, Leadership, Overall Commercial Effectiveness, and Overall Professional Performance (for certain divisions, criteria that were similar in definition were mapped to one of the 9-items)"). See GS0120410 – 28 at GS0120415; GS0120195 – 225 at GS0120208 and GS0120219 – 24; and GS0120172 – 94 at GS0120177 and GS0120190 – 93.

[102] Deposition of Caroline Heller Sberloti Vol. II, July 11, 2013, p. 279 ("Managers always wrote their own evaluation and then they delivered the 360 review feedback along with their own evaluation in a live discussion."). See also GS0119399 – 401 at GS0119401 ("There are three phases to the Review Process: Selection of Reviewers and/or Reviewees (division specific), Review Writing (reviewers complete ratings and comments online), Feedback Delivery (face-to-face discussion between manager/mentor and reviewee based on collated reviews information).").

[103] "Firmwide Review System Frequently Asked Policy, Data & Reporting Questions," May 12, 2009, GS0003383 – 91 at GS0003385.

[104] Declaration of David Landman, June 5, 2015, ¶ 8 ("Before 2011, although written manager summaries were made available to professionals in some Divisions, including the Investment Management and Investment Banking Divisions, it was not the Firm's general practice to share the results of the review in written form with professionals across all Divisions.").

[105] From 2003–2009, employees were rated on a five-point scale. To give greater scope for ratings, the scale was expanded in 2010 to nine points. See GS0004968 – 76 at GS0004971 and GS0004974.

[106] Declaration of David Landman, June 5, 2015, ¶ 8 ("...all professionals in the Firm's Securities, Investment Management and Investment Banking Divisions receive copies of their 360 Performance Review Feedback Reports.").

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- Third, Goldman Sachs changed terminology and modified descriptions for some of the competencies reviewers evaluated.[107]

- Furthermore, in 2014 Goldman Sachs added a "Manager Effectiveness" section to the 360 review, which only applied to Vice Presidents and Managing Directors who managed three or more individuals.[108] This section of the review allowed junior professionals to provide ratings for their managers on ten management-related skills.[109] These manager effectiveness criteria were separate and apart from the other 360 review criteria; however, the evaluation and reviews were done at the same time as the 360 review, and the results were delivered with the 360 feedback reports.[110]

100. **Overall Manager Rating (2016–present):** In 2016, all three relevant divisions changed the way the review process was conducted, shifting away from numerical ratings towards more qualitative feedback.[111] This qualitative feedback is eventually compiled and shared with the reviewee as part of his or her professional development. Numeric scores were replaced with non-numeric categories.[112] As of 2016, all reviewers are asked to provide three forms of assessment:[113]

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[107] See GS0003383 – 91 at GS0003387 for 2009 categories ("The nine firm wide common categories which all VPs and below are rated on include: Technical Skills, Communication Skills, Judgment/Problem Solving, Teamwork, Compliance, Diversity & Equitable Treatment, Leadership, Overall Commercial Effectiveness, and Overall Professional Performance."). See GS0113306 – 12 at GS0113309 for 2011 categories ("Culture and Values, Leadership and People Management ('Leadership' for Analysts), Client Focus (External/Business Partners), Commercial Effectiveness, Diversity and Inclusion, Communication Effectiveness, Technical/Functional Effectiveness (VPs - Analysts), Risk Management, Reputational Judgment and Compliance, EEO Policy.").

[108] Declaration of David Landman, June 5, 2015, ¶ 10 ("The Manager Effectiveness Evaluation referenced above is a new and separate evaluation that was added in 2014 for all Vice Presidents who have three or more direct reports.").

[109] Declaration of Jacqueline Cassidy, May 23, 2018, ¶ 7 ("The Manager Effectiveness section of the 360 allows junior professionals to provide feedback for their managers (outstanding, good, or needs improvement) on ten management-related skills."). See also declaration of David Landman, June 5, 2015, ¶ 10 ("These criteria include the ability to communicate a strategic vision and drive execution; inspire performance, foster the Firm's culture by coaching, developing, and mentoring; provide effective feedback; delegate authority and decision making as appropriate; demonstrate a commitment to developing a diverse team, and respect people's time."). For an example of the form, see "Feedback360+," Summer 2017, GS0380339 – 53 at GS0380347 – 48; and "Annual 360 Feedback," GS0375629 – 31 at GS0375630.

[110] Declaration of David Landman, June 5, 2015, ¶ 10 ("These manager effectiveness criteria are separate and apart from the other 360 review criteria, though the evaluation and reviews are done at the same time as the 360 review and the results are delivered with the 360 Feedback Reports.").

[111] Declaration of Darren Cohen, May 23, 2018, ¶ 5 ("...in 2016 the Firm changed the 360 feedback process by removing numerical scores and focusing on qualitative feedback.").

[112] Declaration of David Landman, October 13, 2017, ¶¶ 6–7 ("Numerical scores have been eliminated. ... Because there are no more scores, the nine-point numerical ratings are no longer part of the 360. Instead, the new 360 Feedback form solicits open comments in two specific categories...").

[113] For an example of the form, see "Feedback360+," Summer 2017, GS0380339 – 53 at GS0380344; and "Annual 360 Feedback," GS0375629 – 31 at GS0375629.

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- A rating of "outstanding," "good," or "needs improvement" for the following competency categories: Risk Management, Reputation, Culture, Compliance, and Conduct.[114]

- Two open responses regarding the reviewee's top strengths and at least one thing the reviewee could be doing differently.[115]

- An assessment of the reviewee's overall performance and contributions as "outstanding," "good," or "needs improvement."[116]

101. In this new framework, an individual cannot select his/her performance manager as a 360 reviewer because "they will deliver a summary of their feedback during the feedback discussion."[117] Performance managers are given all the information from the reviews in a comprehensive report.[118] Performance managers provide their assessment and summary of the reviewee's top strengths and areas for improvement.[119] The performance manager assigns an Overall Manager Rating ("OMR") of "outstanding," "good," or "needs improvement" and provides a written assessment of the reviewee's performance in the areas of: risk management, reputation, culture, compliance, and conduct.[120] The performance manager then delivers this written evaluation during a feedback session with the reviewee.[121]

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[114] If a "needs improvement" rating is given, the reviewer must provide commentary. See Declaration of David Landman, May 26, 2017, ¶ 11.

[115] The open comment responses are designated to one of the following categories: client focus, commercial contributions, communication, culture carrier, functional and technical skills, leadership, people development, risk management/firm reputation, and judgement. See Declaration of David Landman, May 26, 2017, ¶ 10.

[116] Declaration of David Landman, May 26, 2017, ¶ 12 ("The reviewer is also asked to provide an overall assessment of the reviewee by answering whether the reviewee's overall performance and contributions are outstanding, good, or needs improvement.").

[117] "Feedback360+," Summer 2017, GS0380339 – 53 at GS0380343.

[118] Declaration of David Landman, October 13, 2017, ¶ 9 ("All of this information is provided to the professional's manager in a newly designed comprehensive report."). For an example of the form, see "Feedback360+," Summer 2017, GS0380339 – 53 at GS0380349; and "Annual 360 Feedback," GS0375629 – 31 at GS0375631.

[119] Declaration of Darren Cohen, May 23, 2018, ¶ 8 ("When I deliver feedback, I now also provide an annual feedback summary to everyone I manage."). Guidance provided by Goldman Sachs' Human Capital Management includes, "Ensure an Objective and Evidence-Based Summary: Take into account stylistic differences, relationships and proximity as you summarize 360-feedback and add your own perspective on the employee's strengths and areas for development." See "Feedback360+," Summer 2017, GS0380339 – 53 at GS0380350.

[120] Declaration of David Landman, October 13, 2017, ¶ 11 ("...all Vice Presidents and Associates are now provided with written feedback, which includes their manager's overall rating (of outstanding, good or needs improvement), as well as written feedback regarding their top strengths, what they should consider doing differently, and an assessment of their risk management, reputation, culture, compliance and conduct-related behaviors."). Guidance provided by Goldman Sachs' Human Capital Management includes, "Outstanding / Good / Needs Improvement: Reflect your own (and any co-managers) perspective on the employee's performance and contributions." See "Feedback360+," Summer 2017, GS0380339 – 53 at GS0380350.

[121] Declaration of David Landman, October 13, 2017, ¶ 11 ("While the culmination of the 360 Feedback process has always been a meeting between the professional and his or her manager, all Vice Presidents and Associates are now provided with written feedback, which includes their manager's overall rating (of outstanding, good or

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102. **360 reviews are implemented in a decentralized manner.** As noted earlier, by its design, the 360 review process is implemented in a decentralized manner. 360 reviewers need to know the professional being reviewed and the goals that the professional needs to attain. As a result, there are large numbers of individual 360 reviewers involved in the process, and the reviewers for any one individual professional typically differ from the reviewers of other individuals.

103. For example, Plaintiff Mary De Luis received reviews as a class member from 2013–2015. She received 12 reviews in 2013, 11 in 2014, and 10 in 2015.[122] In total, 23 different professionals reviewed named Plaintiff Ms. De Luis over this time.[123] However, 97 percent of the other class members were never reviewed by any of these 23 reviewers, and no other employee shared the exact same set of 23 reviewers.[124] In fact, looking across all class members, **only two class members *ever* received 360 scores based on the exact same set of reviewers as each other**.[125] Nearly every single class member's 360 review scores were determined by a unique set of reviewers.[126]

104. The decentralized implementation of the 360 process also means that 360 reviewers differ significantly across different units and subgroups within GS. For example, in Exhibit 16, I show that there is limited overlap of 360 reviewers across divisions. Taking 2015 as an example, the exhibit shows that 93 percent of reviewers in that year reviewed professionals who were only in *one* division. Less than one percent of 360 reviewers wrote reviews for professionals in all three divisions. In any given year, fewer than 12 percent of 360 reviewers gave

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needs improvement), as well as written feedback regarding their top strengths, what they should consider doing differently, and an assessment of their risk management, reputation, culture, compliance and conduct-related behaviors."); GS0375995 – 6 at GS0375995 ("Feedback discussions are an important opportunity to positively impact your direct reports' performance and engagement...As part of your conversation, you should discuss your report's strengths, accomplishments and development areas, as well as his or her performance with respect to risk management, compliance, culture, and conduct."). See also "Feedback360+," Summer 2017, GS0380339 – 53 at GS0380353.

[122] See Workpaper 1.

[123] See Workpaper 1. My analyses in this section only consider reviews that are relevant for a professional's final 360 review score or OMR. For 2005–2015, I include all solicited reviews. For 2005, I also include added reviews. For 2016–2018, I include all solicited reviews along with the final OMR review itself. I omit 2003 and 2004 from my analysis due to incomplete data. I determine whether reviews are solicited based on the review category description. For 2005–2015, I only include winter reviews for professionals who had no summer reviews with non-missing scores in a given year. For the OMR period, I only include winter reviews for professionals who had no summer reviews in a given year.

[124] See Workpaper 1.

[125] See Workpaper 6.

[126] See Workpaper 6.

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reviews to professionals in more than one division.[127] On average, only 3.3 percent of each class member's reviews came from reviewers outside her division during the class period.[128] Each Business Unit has a unique set of reviewers associated with it, too. On average, professionals in a Business Unit within a year and corporate job title have a total of 114 reviewers; and, on average, less than one percent of these reviewers overlap with reviewers for other Business Units.[129]

Exhibit 16
Nearly all 360 reviewers review professionals in just one division
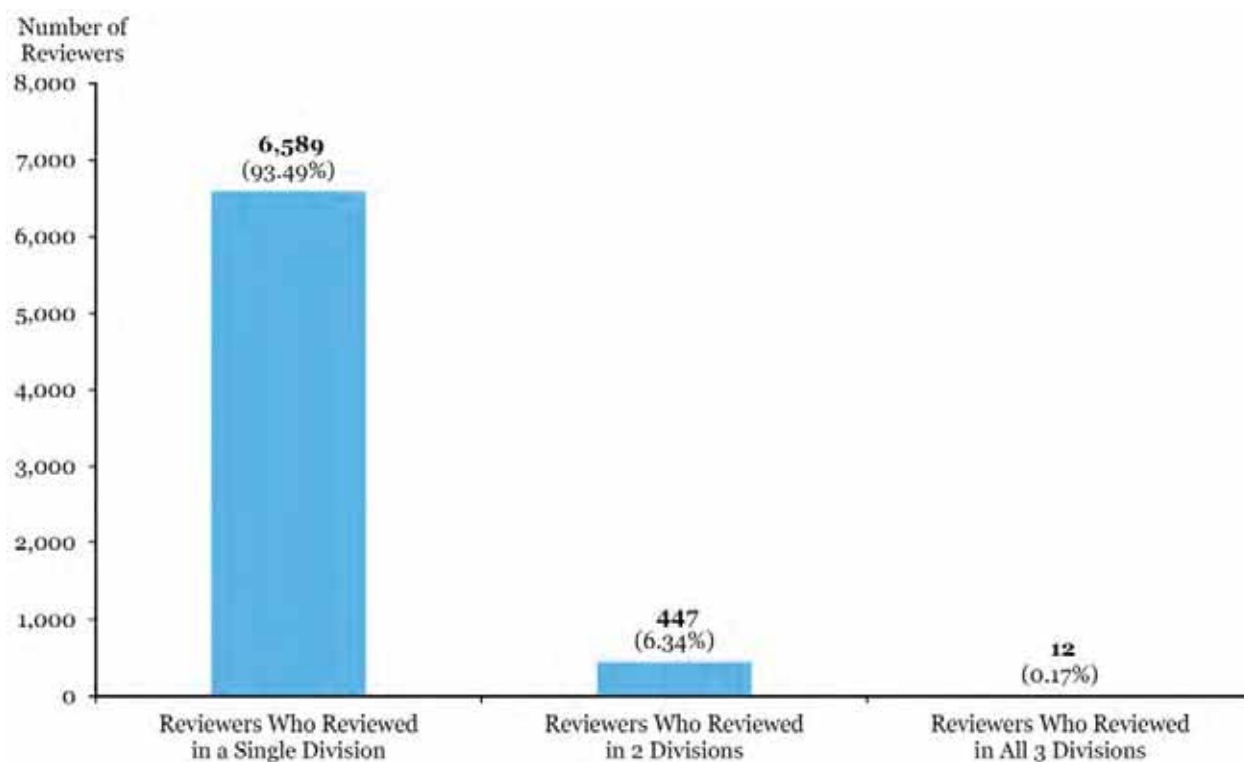
Reviewers in 2015

Number of Reviewers

Source: Goldman Sachs Data Production
Note: The sample consists of reviewers of Associates and Vice Presidents in 2015 who are in the relevant divisions as of the end of the fiscal year. Individual reviewers may review professionals across divisions.

105. The set of 360 reviewers also differs substantially across professionals with different performance managers. As detailed above, in each of the three 360 review frameworks at issue, each professional has a performance manager who aggregates and synthesizes the evaluations that each professional receives in

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[127] See Workpaper 7.
[128] See Workpaper 8.
[129] See Workpaper 9.

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the 360 review process, and who assigns the OMR in more recent years. The performance manager then delivers a summary to the professional herself for development purposes. A performance manager is, thus, a supervisor who has very local knowledge of the workers she manages. For example, a professional's performance manager is virtually always in his or her division (99.6 percent of the time) and in his or her Business Unit (93.1 percent of the time) when I am able to observe this information.[130]

106. Given the central role of performance managers in the 360 review process, and the "local" knowledge they possess, it is informative to look at how sets of reviewers differ across professionals with different performance managers to assess the degree of decentralization. In Exhibit 17, I analyze that question by organizing professionals who share a performance manager into groups, and then I analyze the overlap in 360 reviewers between these groups. Exhibit 17 shows that, on average, these groups have 24 reviewers, and that, on average, only **.12 reviewers** overlap with other performance manager groups. In fact, I find that no two performance manager groups have the exact same set of reviewers in any given year.[131]

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[130] See Workpaper 10. Due to the nature of the produced data, I am only able to identify the division of the performance manager ("primary manager") for 23.1 percent of person-years and the Business Unit of the performance manager for 20.2 percent of person-years. Using that sample, I find that 99.5 percent of class member years have a performance manager in her same Division and 93 percent within her same Business Unit.

[131] See Workpaper 1.

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Exhibit 17

The set of reviewers differs across professionals with different performance managers

In a given year, performance manager groups have an average of 3 professionals each.

Taken together, members of a performance manager group are reviewed by an average of 24 unique reviewers in each year ...

Performance Manager Group A

24 Reviewers for Performance Manager Group A

... with an average of **0.12** reviewers in common with each other performance manager group.

Performance Manager Group B

24 Reviewers for Performance Manager Group B

Source: Goldman Sachs Data Production

Note: The sample consists of reviewers of Associates and Vice Presidents who are in the relevant divisions as of the end of the fiscal year. The average number of professionals per performance manager group is calculated using the number of professionals within a year and corporate job title for each performance manager group. The average number of reviewers per performance manager group is determined using the number of reviewers within a year and corporate job title for each performance manager group. The average number of reviewers in common is calculated using the number of reviewers in common for any pair of performance manager groups within a year and corporate job title, as calculated in Workpaper 9.

107. It is also notable that the overall set of 360 reviewers changes a lot from year to year.[132] In Exhibit 18, I display the number of unique individuals who gave 360 review scores to Securities VPs in each year. The height of each bar represents the total number of 360 reviewers in the given year, for all of the VPs in the Securities division. The total ranges between approximately 550 and 1,800 different reviewers in each year of the class period. The exhibit highlights the constantly evolving set of reviewers by displaying new reviewers as a different shade of blue in each year. The group of reviewers responsible for the 360 review process was almost entirely different in 2018 than it had been in 2005. This pattern holds true across all divisions and corporate job titles.[133]

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[132] In most years each division has hundreds or more individual reviewers (including any reviewers from other divisions) reviewing class members. See Appendix D for year-by-year breakdowns.

[133] See backup to Exhibit 18.

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Exhibit 18

There are many individual decision makers in the 360 review process, and they differ from year to year

Securities Vice Presidents, 2005–2018
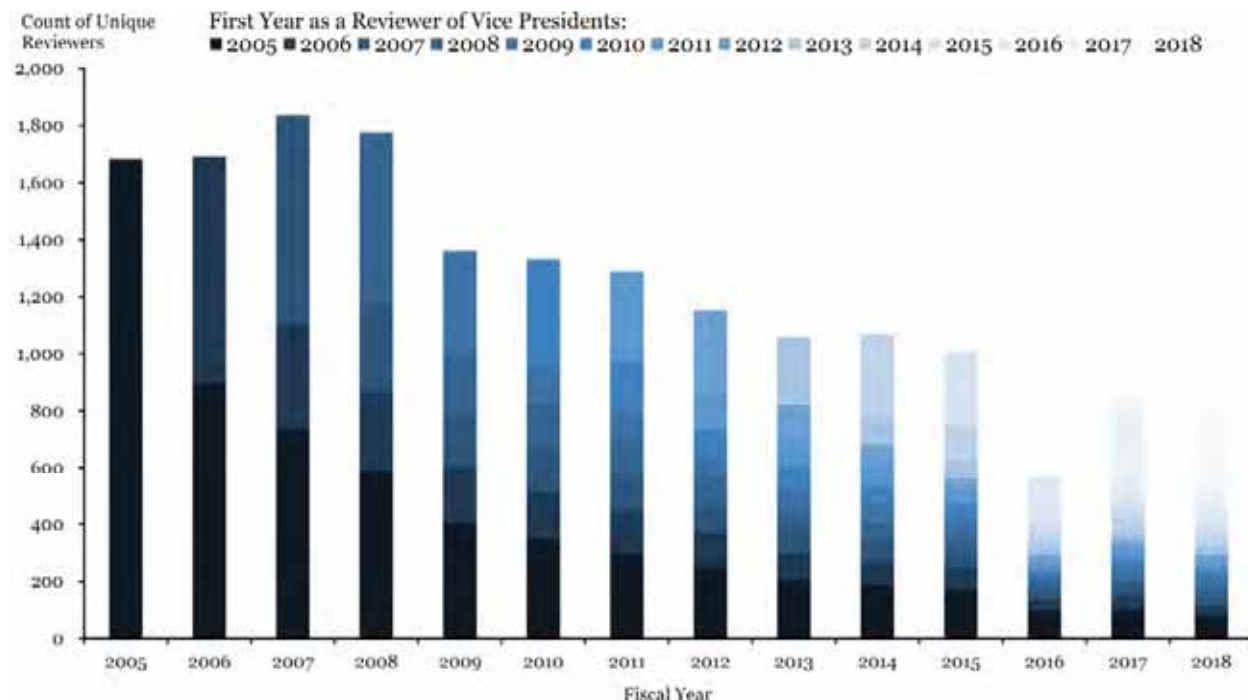
Source: Goldman Sachs Data Production

Note: The sample consists of 360 and OMR reviewers of Securities Vice President class members who are in the relevant divisions as of the end of the fiscal year. Coloring indicates the first year in which a reviewer appears in the data reviewing Securities Vice President class members.

108. The patterns in Exhibit 16 to Exhibit 18 are critical to understanding Plaintiffs' claims in this case because they demonstrate that there is no centralized authority conducting the 360 reviews. Instead, 360 reviewers differ across individual class members, performance managers, Business Units, and divisions. This fact directly contradicts Plaintiffs' assertion that Goldman Sachs's review system is "uniform."[134]

109. The patterns in Exhibit 16 to Exhibit 18 also highlight a fundamental flaw in Prof. Farber's analysis. In order to test Plaintiffs' claims of common bias one must examine gender differences in review scores and compensation across sets of relevant decision makers, and then test whether there is common bias across the sets of decision makers. One cannot simply assume (as Prof. Farber does) that an average gender difference is the same across the many different sets of

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[134] Plaintiffs' Class Cert Motion, p. 4.

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decision makers in involved in the 360 review process. Individual decision makers may implement the process in different ways, and they may exhibit varying degrees of gender bias or none at all; one must *test* for common bias across decision makers—not assume that any average bias is common. I address this issue in more detail in my description of methodology in Section 4 and in the empirical analysis of Section 5.

3.2.2. *Manager quartiling is determined in a decentralized manner*

110. In addition to receiving 360 reviews, professionals are also assigned to a performance "quartile" that reflects their relative position among other professionals.[135] Manager quartiles serve several purposes including: (a) identifying top, middle, and bottom performers, (b) serving as an input to talent management decisions like promotions and program recommendations, and (c) informing compensation and termination recommendations.[136] Plaintiffs claim that there is systemic gender biased in the assignment of quartiles, which contributes to systemic gender-based pay differences.[137]

111. Manager quartiles are assigned by individuals GS calls "quartiling managers,"[138] who may be more senior than professionals' performance managers.[139] The record indicates that in some cases Business Unit heads assign quartiles for professionals in their unit.[140] By its very nature, manager quartiling is a decentralized process, since the decision makers vary across Business Units and must be familiar with a professional's job, individual performance, and the relative performance of each professional's peers. As with 360 reviews, the decentralized implementation of the manager quartiling

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[135] "Performance Quartiling and 'At Risk' Flagging: Process Overviews," 2008, GS0109390 – 9 at GS0109391 ("The Performance Quartile is an assessment of an employee based on performance, contribution, potential and capability relative to the employee's level of experience, position and peer group."). Similar language is used across annual guidelines for manager quartiling; see, for example, "Manager Performance Quartiling," 2017, GS0375658 – 65 at GS0375660.

[136] Talent management decisions include promotions, professional development, mobility, program nominations, etc. Quartiles are considered in terminations of underperforming employees and business reorganizations and downsizings. See "Manager Performance Quartiling," 2017, GS0375658 – 65 at GS0337659.

[137] Plaintiffs' Class Cert Motion, pp. 8–9, 13.

[138] "Manager Performance Quartiling," 2017, GS0375658 – 65 at GS0375660.

[139] Declaration of Jacqueline Cassidy, May 23, 2018, ¶ 8 ("I make manager quartiling placements for my direct reports. For my indirect reports, I ask the managers who report to me to recommend manager quartile placements for their own teams, and I have discussions with those managers about the individuals before coming to a consensus.").

[140] For example, Darren Cohen, head of the Principal Strategic Investment Business Unit in Securities, describes quartiling employees. See Declaration of Darren Cohen, May 23, 2018, ¶ 10 ("I base my manager quartile decisions on my overall assessment of the professional's performance relative to peers in my Business Unit.").

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framework allows GS to maintain performance management practices that are sufficiently flexible so as to be applied across the firm's diverse Business Units.

112. When assigning quartiles, quartiling managers consider the individual's performance, contributions, and potential.[141] Quartiling managers consider feedback from numerous individuals when setting manager quartiles, including performance managers and others.[142] The quartiling managers' decisions are also informed by annual 360 reviews and the OMR. Quartiling managers consider attributes including (but not limited to) commercial contributions, communication skills, technical skills, leadership, and managerial effectiveness.[143]

113. Quartiling managers take into consideration these and numerous other criteria, and assign professionals to one of the following manager quartiles:[144]

- Q1 (top 25 percent): "strongest performance and potential relative to peers."

- Q2 (top 51st to 75th percentile): "strong performance and potential relative to peers."

- Q3 (26th to 50th percentile): "lower performance and potential relative to peers, however on an absolute basis may be a good performer with upside potential."

- Q4 (bottom 25 percent): "lowest performance and potential relative to peers."

- Q5 (bottom 10 percent): Prior to 2016, there was a separate manager quartile reserved for the bottom 10 percent of professionals. During this time, the fourth manager quartile contained professionals in the 11th to 25th percentile. [145]

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[141] See, e.g., "Manager Performance Quartiling," 2017, GS0375658 – 65 at GS0375659.

[142] Declaration of Jacqueline Cassidy, May 23, 2018, ¶ 8 ("I make manager quartiling placements for my direct reports. For my indirect reports, I ask the managers who report to me to recommend manager quartile placements for their own teams, and I have discussions with those managers about the individuals before coming to a consensus.").

[143] "Manager Performance Quartiling," 2017, GS0375658 – 65 at GS0337660.

[144] "Manager Performance Quartiling," 2017, GS0375658 – 65 at GS0337659.

[145] "Manager Performance Quartiling," 2017, GS0375658 – 65 at GS0337659; Declaration of David Landman, October 13, 2017, ¶ 26 ("Previously, Quartile 5 represented the bottom 10% of the population, and Quartile 4 was made up of the remaining 15% of the bottom quarter of the population.").

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114. There is some flexibility in the percent of professionals that fall into each of the manager quartiles. In 2015 this flexibility was formalized, and manager quartiles can deviate by two percentage points without question.[146] Once a consensus is reached, Human Capital Management reviews the manager quartile assignments for mathematical compliance with the parameters around the manager quartiling process.[147]

3.2.3. *"Cross-ruffing" and promotion from Vice President to Extended Managing Director is highly individualized*

115. The process for promotion to Managing Director at GS is designed to identify high performers with strong potential from amongst the VPs and promote these individuals to the next level of leadership at the firm. When Vice Presidents are promoted, they advance to Extended Managing Director ("EMD").[148] EMDs are in charge of groups, Business Units, departments, or teams, depending on the seniority of the EMD.

116. While the promotion from Associate to Vice President follows a defined set of guidelines, and is based primarily on tenure and a base level of satisfactory performance,[149] the promotion from Vice President to EMD is reserved for the strongest professionals (who are successful both commercially and as internal leaders and culture carriers), and therefore involves more discretion and individualized decision-making.[150] The promotion process from Vice President to EMD is a rigorous process that involves the effort of many individuals to "ensure that the process is providing promotions for the people who are most deserving of it."[151] Promotion to EMD "isn't a check the box exercise" and each

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[146] As of 2015, the quartile distribution can be changed by 2 percent with "no questions asked." See Declaration of David Landman, October 13, 2017, ¶ 27.

[147] Deposition of Bruce Larson, June 12, 2013, p. 70 ("The managers submit their quartile recommendations to HCM [Human Capital Management], who looks at that to ensure that there has been a mathematical -- mathematical compliance with the parameters around the quartiling process.").

[148] An Extended Managing Director might then be promoted to Participating Managing Director ("PMD"), i.e. a Partner of Goldman Sachs. See Deposition of Bruce Larson, June 12, 2013, pp. 225–226 ("Q: ...Are managing directors in the investment banking division categorized as either EMDs or PMDs? A: Yes. Q: Is there any other category of MD? A: No. Q: Is a PMD sometimes referred to as a partner? A: Yes. Q: When a vice president is promoted, is it to EMD or to PMD? A: ...A vice president promotion is almost always to EMD.").

[149] See, e.g., Deposition of Bruce Larson, June 12, 2013, Exhibit 163 [GS0004210 – 742 at GS0004210 – 11].

[150] "2017 Managing Director Selection: Cross-Ruffing Best Practices Guide," 2017, GS0375264 – 76 at GS0375265 ("As a cross-ruffer, you are responsible for providing an independent viewpoint on the candidates and sharing feedback with senior leadership to help them make informed, objective decisions regarding the relative strength of the candidates."), GS0375272 (Selection Criteria is broken down into two broad categories: Management, Leadership & Culture and Commercial Effectiveness).

[151] Deposition of Bruce Larson, June 12, 2013, pp. 297–298 ("Employees to be considered...generally need to be performing at a high level and contributing to the organization of the business unit in a manner consistent with what would be expected of a vice president or a manager director...The process in the way the firm and the

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decision is highly specific to the individual and the needs of the Business Units and divisions.[152]

117. There are two primary steps in the promotion process from VP to EMD. I will describe these steps in detail, because I wish to address Plaintiffs' allegations of bias in the second "cross-ruffing" step, and to point out the flaws in Prof. Farber's modelling of promotions that I address in my corrected models.

118. **Step 1: Nomination for promotion.** Across all divisions, the promotion process starts with nomination. Nomination consists of compiling a list of Vice Presidents to be considered for promotion from Vice President to EMD. There are several methods through which a Vice President can be nominated for promotion. In the standard process, Business Unit heads solicit feedback from managers within the Business Unit, and then provide Human Capital Management ("HCM") with a preliminary list of nominees.[153] Prior to 2008, individual Managing Directors could also submit their own nominations by letter or through a nomination website.[154]

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division has gone about that involves a lot of inputs from a lot of different people over a number of years to review and ensure that the process is providing promotions for the people who are most deserving of it.").

[152] Deposition of Jessica Kung Vol. II, August 1, 2013, pp. 428–430 ("A: In IMD, are there any minimum eligibility requirements in order to be a candidate for promotion to MD? A: The candidates have to be strong performing VPs ... in the sense that when you look the various performance measures whether that's financial performance in their business or from a quartile perspective they need to be strong performers. ... Strong performing would be on a relative basis so if an individual had very strong financial results compared to peers, that would be one indication. If the individual had a good quartile compared to peers, that would be another indication. ... Promotion to MD isn't a check the box exercise so in addition to the criteria that's outlined in this and similar documents, in other years business priorities also come into play..."). Deposition of Edith Hunt, September 30, 2020, pp. 68 ("the criteria for promotion is different in different divisions, there are different tasks, there are different responsibilities.")

[153] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, pp. 232–233 ("HCM looked at the nominations, collected nominations from the business heads, collated the list. ... The managing directors have conversations with their business unit heads to submit names at a meeting."); Deposition of Bruce Larson, June 12, 2013, p. 237 ("...as a business unit leader develops his or her slate of candidates, they will typically include conversations of a broad range of other senior people within that business unit who have had interaction with the proposed nominees to get additional inputs into their historical performance as well as potential.").

[154] Deposition of Bruce Larson, June 12, 2013, pp. 258–259 ("I believe back in the 2000 time period, existing managing directors and partners were able to provide independent nomination suggestions with regard to people being cross-ruffed... They were allowed to nominate people to be considered to be cross-ruffed."), p. 276 ("Q: ...Do you know whether in this year, 2004, MDs and partners were still able to independently nominate -- excuse me -- candidates? ... A: I believe that they were. Q: In this year, was there a Web site called the 'Nominations Website' that was a vehicle to do that, rather than nomination letters? A: I believe it was."), and p. 290 ("Q: So is it accurate that as of 2008, there was no more nominations website? A: I believe that's correct."); Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 232 ("...there was a candidate collection tool that used to be used years ago. ... There was a web-based tool where all managing directors could enter candidates...it went from MDs entering nominations into a website.").

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119. After an initial list of nominees is created, there is a series of discussions about each candidate's readiness to be considered for promotion.[155] These discussions include a meeting of Business Unit leaders where the list of potential candidates gets "discussed and reviewed and questioned and challenged by the members of the [divisional] operating committee...and other Business Unit leaders."[156] In recent years, after this initial meeting, all Managing Directors within the division convene to review the nomination list, and can provide input concerning candidates who did not initially make the list.[157] In addition, divisional heads, HCM, and Managing Directors may review the list and provide additional nominees to ensure that good candidates received due consideration, that candidates with conduct issues are subject to additional discussion, and that there is a diverse set of nominees.[158]

120. At each step of the nomination process, various individuals weigh in on the proposed nominees, and there are many opportunities for any Managing Director or Business Unit head to participate. For example, if a Business Unit leader learns that her proposed candidate is unlikely to be included in the final list of nominees, she may exercise her judgment to reach out to the division heads to "further argue their case."[159] Similarly, at or after the meeting of

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[155] Deposition of Bruce Larson, June 12, 2013, p. 227 ("Q: Can you describe how this process works in the investment banking division? ... A: It starts with the global business unit leaders within investment banking developing a list of candidates to be considered for inclusion in the cross-ruffing process. A: Are those nominees? A: Those are nominees to be considered for cross-ruffing.").

[156] Deposition of Bruce Larson, June 12, 2013, pp. 228–229 ("A business unit leader would discuss the slate of nominees from his or her business unit to try to make the case for inclusion in the cross-ruffing process of the people on his or her list. That gets discussed and reviewed and questioned and challenged by the members of the operating committee who are -- and other business unit leaders who are in that meeting."). The Investment Banking operating committee generally consists of "the business unit leaders, major product group leaders, and regional leaders of the investment banking division, in addition to the CFO of the division, the COO of the division, the HCM head of the division, and the heads of the division." See Deposition of Bruce Larson, June 12, 2013, pp. 227–228.

[157] Deposition of Bruce Larson, June 12, 2013, p. 290 ("...as those lists were refined, they were presented in the investment banking division to the broad, entire management director population, in order for those who felt somebody was being overlooked or not being considered as they should have to provide input into the process to make those views heard.").

[158] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, pp. 234–235 ("So, if there were folks that we discussed in any of our career development forms or pipeline discussions that weren't nominated, HCM or the business heads could probe as to why..."); Deposition of Bruce Larson, June 12, 2013, pp. 288–289 ("It refers to efforts led by managing directors representing various affinity networks of diversity within the firm to provide additional support and advocacy to diverse candidates in the process. ... They are just another vehicle that reaches out and connects with both divisional leadership and HCM and others to ensure that candidates from those respective groups are being considered in the process."), Exhibit 159 [GS0004777 – 798 at GS0004791] ("The firm sponsors a range of MD Advocacy efforts that are meant to ensure that the female, Black and Hispanic VPs who are in the promotion zone are brought to the attention of divisional and firm leadership early enough in the MD Selection process to ensure they get the right amount of exposure for their candidacies.").

[159] Deposition of Bruce Larson, June 12, 2013, p. 231 ("So a business unit leader who discussed a slate of candidates might have gotten feedback on a certain number of candidates and gotten an indication that a candidate was not going to be included, he or she would still have the opportunity to further make that case outside of that meeting, additionally, if they felt that the decision -- or the direction the decision was heading

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Managing Directors within the division, anyone may have conversations with members of the divisional operating committee or division heads to further argue their case with respect to any of the proposed nominees.[160] Managers throughout the division are involved in ensuring that each potential nominee is appropriately considered in the nomination process. The final list of nominees, therefore, reflects the individual judgment of many different managers involved in the promotion process. Ultimately, following multiple rounds of discussion, the division heads approve and submit a final list of candidates for the cross-ruffing process to the firm-wide Talent Assessment Group.[161]

121. **Step 2: Cross-ruffing.** Cross-ruffing is the Goldman Sachs process by which a final list of nominees is vetted for promotion. It begins with the selection of cross-ruffers, includes extensive review of nominees, and culminates in the promotion of select nominees to EMD.

122. First, division leaders select cross-ruffers for the year.[162] Concurrent with the process of nominating candidates to be cross-ruffed that takes place within Business Units and divisions, a group of Managing Directors (including both EMDs and PMDs) called "cross-ruffers" are selected by the divisional heads with input from HCM.[163] These individuals are "responsible for providing an independent viewpoint on the candidates" and ensuring that standards are applied in evaluating the candidates.[164] The division heads, along with help from HCM, prepare the list of proposed cross-ruffers for each division that is

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didn't seem to be in a direction that they agreed with. So they would pick up the phone and call the division head and further argue their case.").

[160] Deposition of Bruce Larson, June 12, 2013, pp. 229–230 ("A: ...there is an opportunity, following that meeting, where the entire managing director population of the division gets visibility into the proposed candidates, so that if anybody else has a view or opinion about a -- somebody who is being put forward as a potential nominee for cross-ruffing or not has an opportunity to provide that input. Q: And who would they provide that input to? A: Either the heads of the division, or a member of the operating committee or the HCM. ... There is not a formal process, but they can either raise their hand in the meeting where that's discussed, and raise it then, or they can pick up the phone and reach out to any one of those people that I've described.").

[161] Deposition of Bruce Larson, June 12, 2013, p. 232 ("Following the inputs from the various people that I described through these processes, the division heads sign off on the list that gets turned in to the talent assessment group.").

[162] Cross ruffing guidelines in the record contain lists of cross ruffers; according to these lists, 49 class members served as cross ruffers in relevant divisions during 2002–2018, accounting for about 8 percent of cross ruffers during that period. See Workpaper 11. See also, e.g., "2002 MD & PCP Selection Cross-ruffing Workshop," September 4, 2002, GS0113548 – 67 at GS0113550; and "2017 Managing Director Selection Cross-Ruffing Best Practices Guide," GS0375264 – 76 at GS0375271.

[163] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 214 ("Q: And what are the criteria to select the cross-ruffers? A: So, in the Securities Division, we consider managing directors or partners..."); Deposition of Bruce Larson, June 12, 2013, p. 251 ("Q: Who is eligible to be a cross-ruffer? A: Really, any managing director or partner of the division is eligible to be considered.").

[164] "2017 Managing Director Selection: Cross-Ruffing Best Practices Guide," 2017, GS0375264 – 76 at GS0375265.

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reviewed by the firm-wide Talent Assessment Group.[165] The list of cross-ruffers includes approximately eight to ten Managing Directors for Investment Management.[166] Within Securities, the FICC and Equities sub-divisions each have a team of ten to thirteen cross-ruffers, who meet separately throughout the process.[167] In IBD, the number of cross-ruffers ranges from nine to twenty-one Managing Directors.[168] The selected cross-ruffers are typically individuals who did not participate in the cross-ruffing process for the past two years.[169]

123. Next, cross-ruffers evaluate nominees. Cross-ruffers only evaluate candidates for the division they are assigned to, effectively prohibiting them from evaluating cross-ruffing candidates who come from any other division.[170] Each cross-ruffer forms an overall recommendation on each nominee by interviewing EMDs or Partners from "different Business Units, product areas, divisions and regions" who have an extensive degree of contact with the nominee.[171] A cross-ruffer typically conducts 10 to 12 interviews per nominee

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[165] Deposition of Bruce Larson, June 12, 2013, p. 233 ("...the division identifies potential cross ruffers who would conduct the cross-ruffing as part of the process."), p. 235 ("A: The list of proposed cross-ruffers is generally originated first by the divisional HCM person, and provided to the divisional leaders for their approval and sign off. Q: And which divisional HCM person? A: It would typically be the head of the divisional HCM team."), and p. 240 ("The division heads have final say on the proposed list of cross-ruffers that get submitted to the firm-wide talent assessment group who will also review that list..."). Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 212 ("Q: So you pick the teams at the same time that you're gathering the list to send to TAG, Talent Assessment Group? A: Typically we pick the cross-ruffing list before we collate the candidates. ... Q: So the list that you submit to TAG is both a list of candidates and a list of cross-ruffers? A: And I believe we typically submit the cross-ruffers before we submit the candidates."), p. 213 ("A: And then the cross-ruffer list is decided on with HCM and the division heads and the executive committee."), and pp. 214–215 ("Q: And is there someone who has responsibility to put together an initial list of proposed cross-ruffers that gets discussed at those meetings with the executive committee and the business unit leaders? A: HCM, my team, would put together an initial long list. We'd probably -- in that process we'd take suggestions from a lot of difference business heads and franchise managers. We'd share the long list with the COO and the division heads and get their reaction.").

[166] Deposition of Jessica Kung Vol. II, August 1, 2013, p. 412 ("Q: What's the average size of the cross-ruffing team in IMD? A: In the past few years we've had maybe eight to ten.").

[167] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, pp. 215–216 ("Q: And how many cross-ruffers are there for each division within Securities? A: Somewhere between 10 and 13 between the division. ... Q: So now the TAG has the cross-ruffing list and the candidate list. What happens then? A: The Securities Division cross-ruffers would begin meeting. The FICC teams and Equities teams meet separately.").

[168] Deposition of Bruce Larson, June 12, 2013, Exhibit 162 [GS0109235 – 55 at GS0109255]. See also "2012 Partner and MD Selection: Cross-Ruffing Best Practices," 2012, GS0375517 – 40 at GS0375534; "2017 Managing Director Selection: Cross-Ruffing Best Practices Guide," 2017, GS0375264 – 76 at GS0375271; and "2003 MD Selection Cross-Ruffing 'Best Practices' Workshop," September 3, 2003, GS0109256 – 72 at GS0109258.

[169] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 214 ("Q: And what are the criteria to select the cross-ruffers? A: So, in the Securities Division, we consider managing directors or partners. We're typically looking at people who haven't done it in the past two years because it's a big time commitment. You should be high performing and then we look for a diversified mix on the team across region, function, gender, background.").

[170] Deposition of Bruce Larson, June 12, 2013, Exhibit 162 [GS0109235 – 55 at GS0109241] ("Ask the interviewee if there are any other candidates they would like to discuss ... If they want to discuss someone outside the division, refer the interviewee to the appropriate cross-ruffing divisional team co-captain (see teams on page 20). You should not collect feedback on these candidates" (emphasis in original).).

[171] A cross-ruffer is instructed to "not cross-ruff candidates from an area or function that [they] work with regularly or over which [they] have direct influence." See "2017 Managing Director Selection: Cross-Ruffing Best Practices Guide," 2017, GS0375264 – 76 at GS0375265 ("Prioritize your interview list – focus first on those

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and rates a nominee on categories related to "Management, Leadership & Culture" and "Commercial Effectiveness."[172]

124. Once cross-ruffers complete their interviews, they come up with their overall recommendations, ranging from "Outstanding Candidate" to "No Promotion," and write a one-page summary for each nominee.[173] As the cross-ruffers complete their interviews and determine their recommendations, they meet several times in order to create a ranked list of all nominees for promotion to EMD within a division.[174]

125. This list is then submitted to the firm-wide Talent Assessment Group and shared with the division heads. At this point, the division heads also have the opportunity to submit their own independent ranking to the Talent Assessment Group, which takes into account global business needs of the division that may not be visible to cross-ruffers.[175]

126. Finally, once the two ranked lists are created, the executive office, division heads, captains of the cross-ruffing teams and other senior people at the firm

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interviewees who have an extensive degree of contact with the candidate and ensure there is a mix of interviewees from different business units, product areas, divisions and regions.").

[172] "2017 Managing Director Selection: Cross-Ruffing Best Practices Guide," 2017, GS0375264 – 76 at GS0375266 and GS0375272. Interviews in earlier years focused on categories with slightly different names such as "Commercial Productivity," "Leadership, Culture & Values," and "Running a Business" in 2003. Many of the underlying traits in each category were similar to later years, with slight differences in wording. See Deposition of Bruce Larson, June 12, 2013, Exhibit 154 [GS0109256 – 72 at GS01092566].

[173] The four levels are "Outstanding Candidate," "Strong Candidate," "Borderline Candidate," and "No Promotion." See "2017 Managing Director Selection: Cross-Ruffing Best Practices Guide," 2017, GS0375264 – 76 at GS0375273. For an example of the Candidate One-Page Summary, see GS0375264 – 76 at GS0375276. Prior to 2009, candidates were assigned one of five levels: "One of the best in firm at 'senior' VP level," "Consistently exceeds the results expected," "Solid but not noticeably outstanding," "Acceptable and meets nominal standards," and "Currently below what is needed at MD level." See Deposition of Bruce Larson, June 12, 2013, Exhibit 159 [GS0004777 – 98 at GS0004796].

[174] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, pp. 224–226 ("A: The cross-ruffing teams meet weekly as the interviews are conducted so you'll continue to have meetings as you're conducting interviews…To discuss how the interviews are going and talk about the merits of the candidates. … So, the depth should be relatively consistent, but the number of people you could talk to would vary based on role. I guess as you get further into the process and it becomes more clear who your top and bottom candidates are, you might spent more time on the folks in the middle. Q: But going into the process it's assumed that everybody gets the same sort of level of depth? A: Yes. Q: Okay. And so then how long does the cross-ruffing process take? A: Year to year, it may vary slightly but I would say about five weeks of interviews and meetings of the team. Q: And then what happens? A: The cross-ruffing team produces a ranked list, 1 through N.").

[175] Deposition of Bruce Larson, June 12, 2013, pp. 246–247 ("Q: Do the division heads have the ability to change the rank order of the candidates? A: The rank order was created by the cross-ruffing captains, gets submitted by the cross-ruffing captain. The division heads have an opportunity to submit their own independent ranking to the firm-wide talent assessment group as well. Q: Are they required to do so? A: Yes. Q: And what is the division heads' ranking based on? A: …one factor is the results from the cross-ruffing process that was conducted, the second factor is their business judgment and overlay that reflects the priorities and needs of the various businesses.").

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meet to discuss the ranked nominees.[176] Those meetings focus primarily on the number of EMDs who will be promoted, taking into account the growth potential of divisions, certain businesses, and regions. These meetings result in a final list for promotions that is presented by divisional leadership to the Management Committee shortly before promotions are announced.[177] I have not seen evidence that the Management Committee modifies the list given to them by the division leadership.

127. In conclusion, the entire promotion process is highly individualized and involves a great deal of time and effort from many GS professionals.[178] Each step of the process—from selecting individuals for the nominee list, to selecting cross-ruffers, to completing the cross-ruffing and forming a final rank-ordered list of nominees that determines who will be promoted to EMD—involves the input and judgment of many different professionals.

3.2.4. *Compensation setting at GS is closely tied to Business Unit*

128. Similar to the processes detailed above, compensation setting at GS is implemented in a decentralized fashion. As I explain in this section, compensation decisions for individual professionals are implemented by managers and leaders within each Business Unit. These decisions are based on information collected about professionals' individual performance in their specific role within the Business Unit.

129. Compensation setting at GS begins when each of the three divisions receives its initial compensation budget from the Chief Financial Officer. The

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[176] Deposition of Bruce Larson, June 12, 2013, pp. 247–248 ("Q: What is the next step after those two lists are submitted? A: The cross-ruffing captain has the opportunity to meet with a subcommittee of the management committee of the firm who has been assigned the responsibility of promotions for that particular year and explain the rationale and reason behind their rankings. The division heads have the opportunity to do the same thing with regards to the rankings they have created."); "2017 Managing Director Selection: Cross-Ruffing Best Practices Guide," 2017, GS0375264 – 276 at GS0375270.

[177] "2017 Managing Director Selection: Cross-Ruffing Best Practices Guide," 2017, GS0375264 – 76 at GS0375270; Deposition of Bruce Larson, June 12, 2013, p. 248 ("Q. But which entity has the final decision-making authority? A. The division heads of the business put forward the final list which is ultimately approved by the management committee of the firm.").

[178] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 214 ("Q. And what are the criteria to select the cross-ruffers? A. So, in the Securities Division, we consider managing directors or partners. We're typically looking at people who haven't done it in the past two years because it's a big time commitment. You should be high performing and then we look for a diversified mix on the team across region, function, gender, background."); Declaration of Clare Scherrer, July 26, 2014, ¶ 4 ("I believe that the process for promotions to EMD is robust, fair, and balanced...I have served as both a cross-ruffer and the captain of a cross-ruffing team (both before I moved to London). I have seen first-hand the amount of time and effort that is put into the cross-ruffing process, including training and guidance from Human Capital Management ('HCM') professionals and other managers in the Division.").

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budgets vary each year depending on divisional performance and compensation benchmarking results—i.e., higher performing divisions are allocated more dollars for their professionals.[179] The division then uses its own discretion to allocate the budget to its Business Units, taking into consideration each Business Unit's past performance and contribution to divisional projects and profits throughout the past year as well as its potential for growth.[180]

130. Once Business Units receive their budgets, each individual receives a compensation recommendation from managers within the Business Unit familiar with that professional's role and performance. Managers and Business Unit leaders typically meet to discuss individual professionals' performance and to generate these compensation recommendations.[181]

131. For example, deposition testimony from 2013 (during the middle of the class period) details how decision makers set compensation in each of the three divisions:

- In **IMD**, the "compensation managers" assigned to each employee have responsibility for overseeing compensation decisions.[182] ███████████

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[179] Deposition of Scott Mehling, May 20, 2013, pp. 58–59 ("So there is a process where the CFO and others are involved in determining the firm's overall budget for the year of which based on individual divisional performance there is an allocation process to the divisions on aggregate dollars. … ████████████
██████████████████████████████████ Declaration of Jacqueline Cassidy, October 19, 2020, ¶ 2; Declaration of Kathleen Cupertino, November 12, 2020, ¶ 3; Declaration of Joanna Kozlowski, November 28, 2020, ¶ 2.

[180] Deposition of Jessica Kung Vol. I, July 31, 2013, p. 58 ("So once the budget is allocated to businesses which by the way are allocated based on business units relative performance and contribution to the division during the year…"); Deposition of Bruce Larson, June 12, 2013, p. 61 ("It [investment banking's internal process for managers to make individual employee total compensation recommendations] starts with the heads of the business giving guidance, ██████████████████████████████ See also Securities Compensation Guidelines, "Securities Division Compensation Guidelines: Compensation Managers," October 2017, GS0375846 – 64 at GS0375848; IMD Compensation Guidelines, "Investment Management Division Compensation Guidelines: Compensation Managers," October 2017, GS0375564 – 89 at GS0375566; and IBD Compensation Guidelines, "Investment Banking Division Compensation Guidelines: Compensation Managers," October 2017, GS0375547 – 63 at GS0375549██

[181] Deposition of Jessica Kung Vol. I, July 31, 2013, p. 60 ("The purpose is for the business unit, the managers in the business unit to engage in a dialogue with the business unit head, explain their thought process around how they approached compensation decision making and to get the business head's view which is going to be by nature of he or she being head of the business broader than the manager's individual perspective."). See also Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 65.

[182] Deposition of Jessica Kung Vol. I, July 31, 2013, p. 100 ████████████████
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████ .[183] Business Unit leaders review the submission,[184] and "engage in a dialogue" with the manager to come to an agreement on the initial recommendation.[185]

- In **IBD**, "compensation managers" are responsible for submitting initial compensation recommendations.[186] Compensation managers work with Business Unit leaders to come up with these recommendations.[187]

- In **Securities**, ███████████████████████████████ ██████████████████████████████████████ █████████████████████████████ ██████████[188] Business Unit leaders then meet with these managers to reach a consensus on each compensation recommendation.[189]

132. After relevant managers have submitted updated recommendations, each division's compensation committee reviews the submissions with an eye towards outliers.[190] During these compensation committee meetings,

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[183] Deposition of Jessica Kung Vol. I, July 31, 2013, p. 59 (" ████████████████████████ ██

[184] Deposition of Jessica Kung Vol. I, July 31, 2013, p. 59 ("Q. What's the next step? A. So after managers give their initial recommendations, the recommendations are provided to the leaders in that business or the business unit heads.").

[185] Deposition of Jessica Kung Vol. I, July 31, 2013, p. 60 ("The purpose is for the... managers in the business unit to engage in a dialogue with the business unit head, explain their thought process around how they approached compensation decision making and to get the business head's view which is going to be by nature of he or she being head of the business broader than the manager's individual perspective."). ████████████████████████████

Deposition of Jessica Kung Vol. I, July 31, 2013, p. 62 ████████████████████████████ ██

[186] Deposition of Bruce Larson, June 12, 2013, pp. 68–69 ("Q. And how are IBD compensation managers defined? A. They are the people within the division who have responsibility to submit compensation recommendations for the populations beneath them.").

[187] Deposition of Bruce Larson, June 12, 2013, p. 61 ("Those Business Unit leaders and the compensation managers beneath them work to develop compensation recommendations for the people for whom they're responsible.").

[188] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, pp. 64–65 (████████████████████████ ██

[189] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 65 ("...the managers...will have meetings...with each other and then with the people who run the business unit."), p. 68 ("These meetings are to discuss and come up with the round one recommendations."), p. 70 ("Q. Is that meeting also designed to be a consensus process so everybody essentially agrees with what every person's recommendation is? A. Yes."), p. 122 ("A business leader and a manager would reach a decision together."), and p. 124 ("The business unit leader would...put the final number in, but it would be with the input and the full knowledge of everything the manager had to share.").

[190] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 25 (" ████████████████████████ ██ ██ ██ and pp. 36–39 ("

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discussions of individual compensation decisions tend to be about only a small number of very senior high earners within the division.[191] ███████████

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133. In my data analysis of individual employee records, I find that the vast majority of professionals' final compensation is either exactly equal to, or very close to, the initial compensation recommendation made by managers within

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██ The compensation committee's membership varies, but might include the division head, COO, CFO, and heads of HCM. In Securities as of 2013, Business Unit leaders were members of the compensation committee. See Deposition of Jessica Kung Vol. I, July 31, 2013, p. 40; Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 57.

[191] Deposition of Jessica Kung Vol. I, July 31, 2013, pp. 86–87 ("I would say again the compensation committee meeting starts off and it focuses on the businesses approach and philosophy to compensation and allocation and macro themes. To the extent that individual recommendations are discussed, they do tend to be the more senior employees who also tend to be the ones that are more highly paid."); Deposition of Bruce Larson, June 12, 2013, pp. 62–63 ("In those meetings, the comp managers have to support the recommendations that they've made. There is questioning that takes place to ensure consistency across regions and business, where appropriate. … And as part of that meeting, individual compensation recommendations for the seniormost people in the division are discussed and – and reviewed.") and p. 96 ("Q. Was it the practice of the compensation committee to review every individual's compensation proposal in IBD? A. No. Q. How did the compensation committee decide which individual's compensation proposals to review? A. The compensation committee typically focused on the most highly paid individuals and, therefore, the individual comp recommendation focus was largely on the most highly paid individuals in each business unit."); Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, p. 26 ("Compensation decisions are made by the managers. The compensation committee will discuss a handful of folks, but they don't discuss large numbers of individuals and so there's no sign-off process.").

[192] Deposition of Jessica Kung Vol. I, July 31, 2013, pp. 95–96 ███████████████████████
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█████ Deposition of Bruce Larson, June 12, 2013, pp. 79–81 ("████████████████████████
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the Business Unit (when data on initial recommendations is available).[193] This indicates that managers and Business Units are the relevant decision-making units of interest for compensation decisions.

134. The process outlined above determines each professional's PATC. In turn, a professional's PATC determines his or her bonus for the current year, which is determined formulaically as the difference between PATC and current-year salary.[194] Current-year PATC can affect a professional's salary in the following year (subject to certain constraints).[195] Current-year PATC does not, however, determine PATC in the next year.[196]

135. One notable exception to the process outlined above is compensation setting for self-sustaining Private Wealth Advisors ("SSPWA"), which is formulaic.[197] SSPWAs are part of the Private Wealth Management ("PWM") sub-division of IMD.[198] ████████████████████████████████
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[193] See Workpaper 12.

[194] See, e.g., "2007 Detailed Compensation Communication Guide For HCM," GS0113786 – 807 at GS0113791 ████████████████████████████████████
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[195] See, e.g., "Historical Salary Summary," 2012, GS0113480 – 2; "Summary of the GS Salary Model," 2008, GS0122847 – 50 at GS0122847; Deposition of Scott Mehling, May 20, 2013, p. 227 ("… our total comp drives salary and as total comp increases, salary as a percent of total comp decreases."); "2015 Manager Compensation Communication Guide," 2016, GS0375758 – 66 at GS0375765 ████████████████
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[196] See, e.g., "2015 Manager Compensation Communication Guide," January 2016, GS0375758 – 66 at GS0375765 (██
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[197] For examples of self-sustaining PWA compensation guidelines, see PWM 2007 Compensation Memo, "2007 Compensation Changes," November 27, 2006, GS0118170 – 1 at GS0118170; PWM 2008 Compensation Memo, "2008 Compensation Changes," April 11, 2008, GS0118180 – 1 at GS0118180; PWM 2010 Compensation Memo, "PWA Compensation," December 3, 2010, GS0118196 – 8 at GS0118196; PWM 2011 Compensation Memo, "2011 Compensation Changes," April 8, 2011, GS0118203 – 5 at GS0118203.

[198] Within PWM, certain employees are categorized as Private Wealth Advisors ("PWA"). PWAs fall into two groups: "'self-sustaining' PWAs (who, unlike any other role in the revenue divisions, work on a straight commission basis) and 'non self-sustaining' PWAs (who receive a salary and are eligible to be considered for a bonus)." See Declaration of Megan Taylor, June 30, 2014, footnote 1. Goldman Sachs internal documents will sometimes ████████████████████████████

[199] See, e.g., PWM 2008 Compensation Memo, "2008 Compensation Changes," April 11, 2008, GS0118180 – 1 at GS0118180 ("██
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██████.[200] Because their formulaic compensation scheme differs so sharply from other professionals', I will analyze SSPWAs separately in the tests below.

3.3. The decision-making processes are the basis for the statistical model needed to analyze the Plaintiffs' claims

136. In this section, I discuss the implications of the preceding facts for the statistical analysis of Plaintiffs' claims. In particular, the decentralized implementation of the challenged processes implies that one must evaluate gender differences in outcomes across different sets of decision makers and *test* whether those differences are systemic. Prof. Farber fails to do this, and as a result, his methods are fundamentally flawed and unreliable.

137. As the preceding sections make clear, the review and promotion processes and compensation setting at GS are implemented in a decentralized, individualized manner. Individual professionals perform specialized jobs within their divisions, Business Units, and functions, and distinct sets of individual decision makers have discretion to evaluate each class member in the context of her specific job. These facts directly contradict the Plaintiffs' claim that there is a common review process implemented in a uniform fashion.

138. As I emphasize in Sections 4 through 6, these facts must be accounted for in any statistical analysis of Plaintiffs' claims of systemic bias. In particular, in order to test Plaintiffs' claims of systemic bias one must examine gender differences in review scores and compensation across sets of relevant decision makers. As I explain throughout the remainder of this report, Prof. Farber does not do this. Instead, he examines only the average gender difference in review scores and compensation across *all three divisions combined*. He then *assumes* this average gender difference is the same across the many different decision-making units. This approach is not consistent with how the processes at issue actually work, and therefore not consistent with statistical standards.[201] In addition, the failure of Prof. Farber to test his assumption leaves the

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[200] See, e.g., Investment Management Compensation Guidelines, "Investment Management Division Compensation Guidelines: Compensation Managers," November 2012, GS0375428 – 50 at GS0375434 – 5 ██

[201] James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Third Edition Update, (Pearson, 2015), pp. 232–234 ("The starting point for choosing a regression specification is thinking through the possible sources of omitted variable bias…A control variable is not the object of interest in the study; rather it is a regressor included to hold constant factors that, if neglected, could lead the estimated causal effect of interest to suffer from omitted variable bias.").

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fundamental issue of whether or not the class members have been similarly impacted by the firm processes unanswered.

139. Given the centrality of this issue to Plaintiffs' claim, in my empirical analyses of the challenged processes, I analyze evidence of bias across different organizational units within the firm where key decision makers differ. Depending on the process being analyzed, I focus on division and/or Business Unit. This approach allows me to directly test—rather than assume—whether different decision makers implement the processes differently and whether the impact on class members is similar.

140. The relevant organizational units I analyze differ depending on the process I am analyzing.

- In general, I analyze all outcomes at the **division** level, given the clear evidence (detailed above) that divisions have distinct business objectives, evaluate their professionals using different metrics, and have distinct groups of decision makers who implement the challenged processes.

- I also analyze gender gaps in 360 review scores, manager quartiling, and compensation across Business Units. For 360 review scores, this allows me to compare alleged gender gaps across finer collections of individual reviewers. For manager quartiling, this allows me to account for the fact that manager quartiles are assigned within Business Units. For compensation, this allows me to account for the fact that compensation budgets are set at the Business Unit level and Business Unit leadership confirms compensation allocations.

- I detail each of these methodological choices in the relevant sections below.

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4. PROF. FARBER'S METHODOLOGIES FOR ANALYZING ALLEGED BIAS HAVE SEVERAL FUNDAMENTAL FLAWS

141. Before presenting the details of my analysis, I provide an overview of Prof. Farber's methodology in order to explain why the analysis I provide and the methods I use differ from his.

142. As I have stated, a basic principle of econometric research is that the regression model should be tailored to the research question at hand, and that it should reflect the environment that is being modeled.[202] Using evidence from the environment, a researcher must consider variables they omit or are unable to include in a regression when interpreting their results.[203] Prof. Farber's analyses of the challenged processes rely heavily on regression analysis, but he ignores evidence of how the challenged processes are conducted. Academic economic research and legal precedent recognize that the reliability of any regression analysis (or statistical model more generally) depends on how it is applied to the relevant research question, and how well it can account for factors in the underlying decision process.[204]

4.1. Omitted variable bias in Prof. Farber's regression analyses of 360 reviews, manager quartiling, promotion, and compensation

143. In his analyses of 360 review scores, manager quartiling, compensation, and promotion, Prof. Farber ignores certain variables that are important to the decision-making process. In a regression model like Prof. Farber's, any variable that differs by gender and that is important to the decision-making process, but

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[202] Daniel L. Rubinfeld, "Reference Guide on Multiple Regression," in *Reference Manual on Scientific Evidence*, Third Edition, (Washington, DC: The National Academies Press, 2011), pp. 303–357 at p. 312 ("Failure to develop the proper theory, failure to choose the appropriate variables, or failure to choose the correct form of the model can substantially bias the statistical results—that is, create a systematic tendency for an estimate of a model parameter to be too high or too low.").

[203] James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Third Edition Update, (Pearson, 2015), pp. 232–234 ("The starting point for choosing a regression specification is thinking through the possible sources of omitted variable bias…A control variable is not the object of interest in the study; rather it is a regressor included to hold constant factors that, if neglected, could lead the estimated causal effect of interest to suffer from omitted variable bias.").

[204] Daniel L. Rubinfeld, "Reference Guide on Multiple Regression," in *Reference Manual on Scientific Evidence*, Third Edition, (Washington, DC: The National Academies Press, 2011), pp. 303–357 at pp. 308–309 ("Multiple regression analysis can be a source of valuable scientific testimony in litigation. However, when inappropriately used, regression analysis can confuse important issues while having little, if any, probative value. … courts have rejected regression studies that did not have an adequate foundation or research design with respect to the issues at hand.").

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that is *excluded* from the regression model, will cause what economists call "omitted variable bias" in the estimate of the gender gap.[205]

144. Omitted variable bias is an important consideration because many dimensions of performance and production that are hard to measure, and that vary by role, inform how large firms evaluate and pay professionals.[206] For example, decision makers at GS use available production measures, information on jobs, 360 review scores, and manager quartiles to help measure performance and production. While these are imperfect measures, they are proxies for performance that compensation managers and Business Unit leaders use to help set pay. These proxies are based on the job each professional performs and are specific to their role.[207]

145. Turning back to Prof. Farber, he effectively admits that omitted variable bias may be an issue for his findings; his own report explains that the gender gap he estimates captures the effect of all "unmeasured" variables **not** in his model.[208] In other words, Prof. Farber acknowledges that his gender gap

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[205] James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Third Edition Update, (Pearson, 2015), p. 183 ("If the regressor…is correlated with a variable that has been omitted from the analysis…and that determines, in part, the dependent variable…then the OLS estimator will have omitted variable bias. Omitted variable bias occurs when two conditions are true: (1) when the omitted variable is correlated with the included regressor and (2) when the omitted variable is a determinant of the dependent variable.").

[206] Edward P. Lazear and Michael Gibbs, *Personnel Economics in Practice*, (John Wiley & Sons, Inc, 2015), p. 208 ("Organizations often go to great lengths to quantify an employee's contribution to firm value. Quantitative measures have several advantages. Because they are numeric, they can be tied to compensation more easily (e.g., by computing a bonus using a formula). Many performance metrics are readily available through the normal course of business. Accounting systems, for example, are large-scale performance measurement systems. Where the accounting numbers accord well with an employee's contribution, they are often used for computing bonuses or as input into promotion decisions, for example, Firms may use hours worked, customer satisfaction, and other quantitative information as input in evaluations."), p. 215 ("Because the purpose of the performance measure is to estimate and motivate the employee's contributions to the firm's objectives, it is important to match the measure to the job design. The performance measure will vary with the extent to which the job involves specialization or multitasking and the extent to which the employee is given the discretion to make few or many decisions."), and p. 227 ("An ideal performance evaluation for incentive purposes is one that captures all of the effects of an employee's actions on firm value, but nothing else. These are often called controllables and uncontrollables, but the concepts are rarely defined carefully.").

[207] Securities Compensation Guidelines, "Securities Division Compensation Guidelines: Compensation Managers," October 2017, GS0375846 – 64 at GS0375856–7; IMD Compensation Guidelines, "Investment Management Division Compensation Guidelines: Compensation Managers," October 2017, GS0375564 – 89 at GS0375575–7; and IBD Compensation Guidelines, "Investment Banking Division Compensation Guidelines: Compensation Managers," October 2017, GS0375547 – 63 at GS0375556–7.

[208] Farber Report, ¶¶ 55–57 ("The coefficients of the model are estimated using multiple regression analysis, and these estimated coefficients are used to compute a prediction of pay for each worker based strictly on the factors included in the model. Estimates of the unmeasured factors are then computed as the difference between the actual pay level and the predicted pay level. This difference is called the residual. If pay is determined in a non-discriminatory fashion, then these residuals will not be systematically related to the sex of the worker. If there is a systematic relationship such that women are paid less, on average, than predicted by the factors included in the model, then I would conclude that the analysis provides statistical evidence of discrimination. The actual calculation is done in a single step by including in the model a variable that indicates which observations relate to women. The central result of the multiple regression analysis in this case is an estimate of the effect of being a woman on pay, accounting for differences between men and women in the other factors included in the model.

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estimates are not limited to the alleged "gender bias." What he fails to explain is that his estimates capture differences between men and women across *all factors not in his model.* And indeed, as I explain in more detail below, because he excludes key variables, his analyses suffer from omitted variable bias.[209]

146. When analyzing **360 review scores**, Prof. Farber chooses to omit or ignore variables like:

- **Production measures** that capture a professional's individual performance, productivity, and contributions to the firm, such as salespeople's sales credits in Securities.

147. When analyzing **manager quartiles**, Prof Farber chooses to omit or ignore variables like:

- **Production measures**, as described above.
- **360 review scores**, which are some of the most comprehensive measures in GS data for capturing a professional's performance, contributions, and overall skill in executing her role.

148. When analyzing **compensation,** Prof. Farber chooses to omit or ignore variables like:

- **Production measures**.
- **360 review scores and OMRs**.
- **Manager quartile**, which is considered in compensation setting.
- **Business Unit**. Prof. Farber excludes Business Units in some regressions. Recall from Section 3 that each Business Unit is allocated a total budget for compensation, where that budget is derived from the Business Unit's contributions and varies in size on a per capita basis. This is then allocated by managers and Business Unit leadership to professionals within that Business Unit, reflecting the contribution of each professional to the Business Unit. To ignore or omit Business Unit

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The estimated effect of being a woman on pay in this model is a measure of the relationship between sex and the unmeasured factors affecting compensation.").

[209] **See Appendix C for a complete list and detailed description of the variables I include in my 360 review, manager quartiling, promotion, and compensation regressions.**

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in the compensation regressions is to ignore the way the professionals are paid for the value to the firm of the jobs they perform.

- **Function,** which delineates important differences in job functions across individual professionals.

149. When analyzing **promotion**, Prof. Farber omits or ignores all of the variables listed above:

- **Production measures.**
- **360 review scores and OMRs.**
- **Manager quartiles.**
- **Business Unit and function**.

150. As shown above, a significant limitation in Prof. Farber's compensation and promotion regression models is that he ignores important differences across the multitude of individual jobs that are filled by Associates and Vice Presidents at Goldman Sachs, instead using broad "Affirmative Action job groups" ("AA job codes") that fail to fully distinguish between different jobs (see discussion in Section 3.1.5). At a minimum, Prof. Farber should control for Business Unit and function.

151. To illuminate the econometric issues at hand I will use as an example the regression model for compensation; however, these issues also apply to all of the statistical models I present for the challenged processes. I will use mathematical notation: Prof. Farber presents a model in which compensation for any individual, denoted $Comp_i$, is a function of a collection of individual i's characteristics, including whether that individual is female (denoted by F_i), a collection of the individual's other traits (e.g., age, tenure; denoted X_i), as well as the division (denoted by Div_i) in which the individual works. The regression equation Prof. Farber estimates for compensation looks as follows:

$$Comp_i = \beta_0 + \beta_1 F_i + \beta_2 X_i + \beta_3 Div_i + \epsilon_i \ (1)$$

152. Each variable in Equation 1 has a "coefficient" that measures the incremental effect of that variable on compensation, holding constant the other

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variables in the equation.[210] For example, the coefficient on the indicator variable for whether a professional is a Female (F) is β_1, which measures the effect of gender on compensation, holding all other variables constant. Prof. Farber assumes that the effect of gender on compensation represents "discrimination," based on **his assumption** that his model includes all of the important factors that affect compensation and are correlated with gender. However, Prof. Farber's assumption is incorrect if his model omits important variables that are correlated with compensation and gender. Indeed, Prof. Farber erroneously omits many variables from X_i in Equation 1 that were identified in Section 3 as keys to setting pay, such as function and Production.

153. Using Production as an example: if individual compensation is actually set as a function of Production ($Prod_i$) in addition to all of the variables Prof. Farber includes in his regression, then the true model is as follows:

$$Comp_i = \beta_0 + \beta_1 F_i + \beta_2 X_i + \beta_3 Div_i + \beta_4 Prod_i + e_i \ (2)$$

154. Where β_4 represents the relationship between production and compensation. Remember production reflects a professional's performance, productivity, and contributions to the firm, such as salespeople's sales credits in Securities. If one estimates the Equation 1 when Equation 2 is the true reflection of the underlying processes in determining compensation, the gender coefficient β_1 as modeled in Equation 1 would incorrectly attribute compensation differences to gender that are actually due to another factor, production, in so far as F_i is correlated with $Prod_i$.

155. For example, suppose the relationship between F_i and $Prod_i$ is the following:

$$Prod_i = \ p_0 + p_1 F_i + \delta_i \ (3)$$

156. Here, p_i represents the average difference in production between male and female professionals. By not including production in Equation 1, the effect of production is contained within the error term in Equation 1: $\epsilon_i = \beta_4 Prod_i + e_i$. Because production impacts compensation, if production differs on average by gender, according to Equation 3, estimating a regression without production will assign the effect of production on compensation to the effect of being

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[210] The error term, ϵ_i , measures the difference between actual compensation and the expected compensation, given the control variables in the regression. The "constant" term, β_0, is the expected compensation if all variables were equal to zero.

female. In the case here, **production in fact does differ on average by gender**, **so estimating a regression without production will incorrectly assign the effect of average gender differences in production to the average effect of being female.** In other words, if, on average, women have lower production than men in the data, then the estimated effect of being female will be overstated because it is conflating gender differences in production with effect of gender itself.

157. Specifically, estimating compensation using Equation 1 instead of Equation 2 would result in the following:

$$Comp_i = (\beta_0 + \beta_4 p_0) + (\beta_1 + \beta_4 p_1)F_i + \beta_2 X_i + \beta_3 Div_i + (e_i + \beta_4 \delta_i) \ (4)$$

158. Equation 4 shows mathematically the effect of using a regression to estimate Equation 1, which is subject to omitted variable bias. The regression will estimate a *single* coefficient for female, equal to the blue term, $(\beta_1 + \beta_4 p_1)$. However, this coefficient is not simply β_1, the true effect of female on compensation, it also contains p_1, the gender gap in production, as well as β_4, the effect of production on compensation. Therefore, one cannot draw conclusions about the true effect of gender on compensation from the coefficient resulting from the regression that omits production because the coefficient will also capture the gender differences in production. To interpret the results of Equation 1 to be true measures of bias would be statistically incorrect.

159. The effect of omitted variable bias is made especially clear when I analyze a subset of professionals in IMD called self-sustaining Private Wealth Advisors ("SSPWAs"). As I described in Section 3.2.4, SSPWAs are paid formulaically based on a measure of "credits" that reflects the revenue that each individual PWA generates for GS. Importantly, this measure is available in the data produced in this case. Thus, these professionals offer an opportunity to assess how the gender gap changes when one incorporates complete information about the performance and production variables that influence—and for SSPWAs, determine—individual compensation. I illustrate this example in Exhibit 19.[211]

- The first orange bar in Exhibit 19 displays the results of a naïve comparison of men and women's PATC for SSPWAs that ignores all

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[211] I start the analysis in 2009 because data on credits is unavailable in earlier years.

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other variables besides gender. This first orange bar shows that women SSPWAs earn 28 percent less than men SSPWAs. The blue bar on top summarizes the R-squared or "fit" of the model.[212] The low R-Squared of 3 percent shows that gender itself explains almost no variation in PATC.

- The second orange bar reports the gender gap in compensation after controlling for the variables Prof. Farber includes in his compensation model 2a.[213] This model does not include "credits," which is the productivity measure relevant for SSPWAs. According to Prof. Farber's incomplete model shown above, there is still a significant gender gap in compensation of 17 percent—but that is because his regression suffers from omitted variable bias by not including credits. The second blue bar measures the R-squared and indicates that variables included in Prof. Farber's model can explain about 59 percent of the variation in PATC, suggesting that important explanatory variables may be missing from the model.

- The third orange bar includes credits that I add to the regression. Controlling for credits, the compensation gap is now 1 percent and is no longer statically distinguishable from zero. In addition, the blue bar in the third column indicates that by including credits, the model is able to explain nearly *all* of the variation in SSPWA pay.

- In fact, the fourth blue and orange bars describe a regression with only gender and credits, showing that controlling for credits alone explains essentially all of the variation in SSPWA pay, as indicated by the R-squared of 97 percent—which is what we would expect given my understanding of how these professionals are compensated.

160. In this example, it is credits, *not gender,* that explain the difference between men and women's PATC. When we exclude credits from the regression model, the regression mistakenly confounds the effect of gender with the effect of *gender differences in credits*. Men SSPWAs earn higher credits than women; men's higher PATC reflects higher credits, not gender bias. This is a stark example of how omitting a key determinant of compensation can sharply affect

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[212] James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Third Edition Update, (Pearson, 2015), p. 121 ("The [R-squared] and the standard error of the regression measure how well the OLS regression line fits the data. The [R-squared] ranges between 0 and 1 and measures the fraction of the variance of Y that is explained by X.").

[213] See Farber Report, Tables 15–16.

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one's regression results, leading to very misleading conclusions about alleged gender bias.

Exhibit 19

After properly controlling for production, there is no gender gap for self-sustaining PWAs

Vice Presidents, 2009–2018
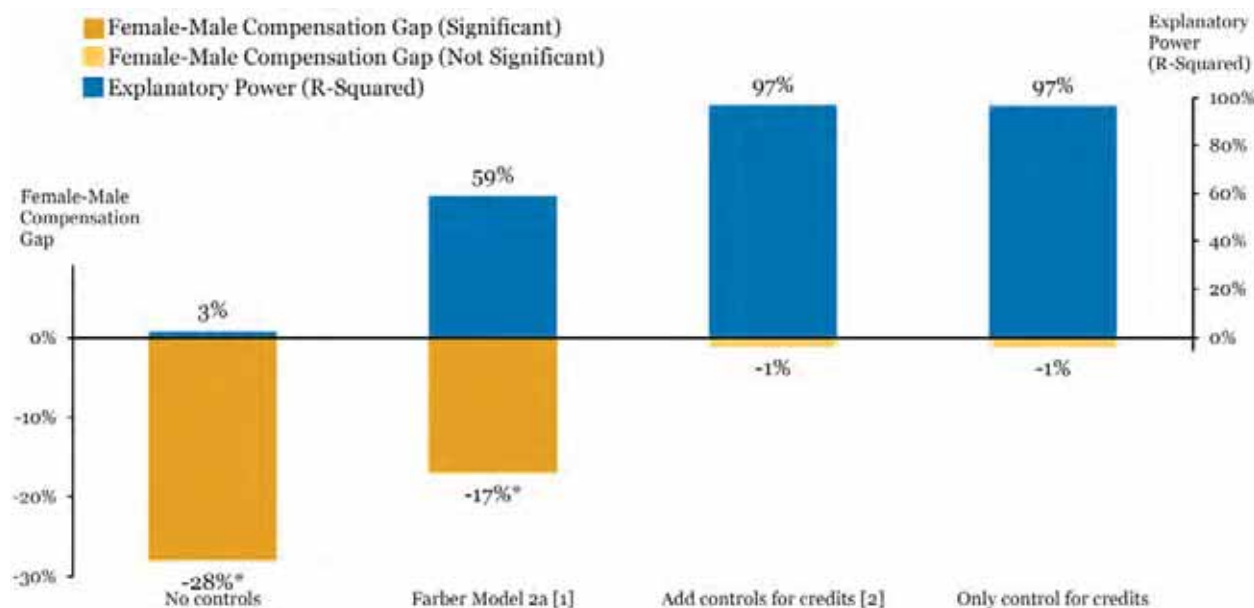
Source: Goldman Sachs Data Production

Note: The sample consists of Vice Presidents in Investment Management as of the end of the fiscal year who had non-missing PATC, non-missing manager quartile, non-missing 360 review score / OMR, and who were self-sustaining Private Wealth Advisors with non-missing credits. "*" after estimate indicates statistical significance of the coefficient at the 5% level. Standard errors are clustered at the individual professional level.

[1] Controls include year, location, education, tenure, related prior experience, AA job group, whether a professional was a lateral hire, and whether a professional was a new lateral hire.

[2] Controls for credits include log credits, an indicator for credits above $500,000, and an interaction between this indicator and log credits. There is a floor on SSPWA compensation of around $150,000 in the data. When credits fall below the level at which predicted compensation would be below $150,000 (approximately $500,000 in credits), compensation does not drop any further. To account for this, I include the indicator for when credits exceed $500,000 and interact this with log credits.

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161. Plaintiffs argue that Prof. Farber was right to exclude production metrics (such as credits) from his models because the available metrics do not perfectly capture the performance of each professional.[214] This reasoning is entirely backwards. As I show in Section 6, the limited production measures that are

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[214] Class Cert Hearing, October 22, 2014, p. 45 ("Here is why, in this opening report, Dr. Farber did use the production variable. In this context, a person's profit and loss is almost meaningless without context. Depending on the product the person is selling, a person might have a product that has a recurring high revenue, and if a person has that recurring high revenue, they may not be the best performer, they should have done even higher than what number they achieved. Whereas, a person that has a very difficult and low-performing product that they are able to reduce risk on and have a low negative, they might be one of the strongest performers in their group, the P and L won't tell you that just as a data point. Out of the context, it is very unclear."). Prof. Farber also suggests that production metrics may not fully capture the "contributions" of each individual. Expert Rebuttal Report of Henry Farber, January 28, 2014, ¶¶ 118–119.

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available in the data still explain a substantial share of differences in compensation across employees. The limitations of the available measures simply illustrate that omitted variable bias remains a concern *even in a corrected model that includes production controls*. In Section 6, I show that the pattern in Exhibit 19 holds among other groups of professionals: when I add the available production measures to the model, the estimated gender gaps shrink. This suggests that any remaining gaps may be explained by omitted production information. I discuss such omitted information further in Section 6.3.

162. As noted above, Prof. Farber acknowledges the statistical principles displayed in my SSPWA example.[215] He explicitly states that his estimate of the gender gap will include the effects of all unmeasured factors not in his regression that are also correlated with gender. Yet, he omits many variables that are available to him and that I include. Based on my understanding of the review and compensation processes as described in Section 3, I will present a model that adds variables that matter for compensation setting into Prof. Farber's model that Prof. Farber omits. By doing so, I can directly test whether Prof. Farber's model suffers from omitted variable bias and then quantify the magnitude of that omitted variable bias, similar to what I did in Exhibit 19.

4.2. Prof. Farber's regression models suffer from misspecification error as they do not incorporate the decentralized nature of the relevant decision-making processes at issue in this case

4.2.1. It is important to use a regression model that reflects the decentralized nature of decision-making at GS

163. I established in Section 3 that jobs differ across and within divisions and Business Units, and that the decision makers who assess performance, evaluate candidates for promotion, and engage in compensation setting will base their evaluations on their understanding of these differences. Therefore, it is important to have models that permit estimated gender gaps to vary across relevant organizational units and decision makers.

164. Prof. Farber does not allow the gender gap to vary over decision-making units. For each of his analyses of the challenged review processes, promotion process, and compensation setting, Prof. Farber estimates one regression model

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[215] Farber Report, ¶ 57 ("The central result of the multiple regression analysis in this case is an estimate of the effect of being a woman on pay, accounting for differences between men and women in the other factors included in the model. The estimated effect of being a woman on pay in this model is a measure of the relationship between sex and the unmeasured factors affecting compensation.").

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for all VPs, regardless of division or Business Unit; and one regression model for all Associates, regardless of their division or Business Unit. This is problematic because Prof. Farber's regression measures only **the average difference** in outcomes between men and women, controlling for variables included in the model.

165. The flaw in Prof. Farber's model is that he ignores this variation in job duties and in decision makers across Business Units and divisions; therefore, his model suffers from misspecification error. As a result, Prof. Farber's model is methodologically incapable of testing Plaintiffs' claim of common bias because the model, by its design, estimates a single, average gender gap that applies equally to all professionals in each division and Business Unit at all points in time. Finding an average gap in his regressions is simply *not* evidence of common bias. For example, as I show below in Section 5.1.1, on average, female professionals in IMD receive 360 review scores that were not statistically different from those of their male counterparts prior to 2010. In Securities, on the other hand, there is a statistically significant gender difference in scores during that period. A regression that combines the data from the divisions and reports a single gender gap estimate would not be capable of describing the differences across divisions.

166. The record is clear that the decision makers involved in review and compensation setting differ across units of the firm, including Business Units and divisions, and are evaluating professionals by using different criteria across those units. As I discussed above, professionals have very different job responsibilities across Business Units, and are evaluated by distinct individuals. Further, these different sets of decision makers have discretion to consider the variables that are relevant to assessing each individual. Prof. Farber does not analyze whether alleged gender gaps vary across decision-making units.

167. Prof. Farber's misspecification error is displayed in the following set of equations. To make this more concrete, consider the following three compensation regression for VPs:

$$VPs\ in\ IBD:\ Comp_i^{IBD} = \beta_0^{IBD} + \boldsymbol{\beta_1^{IBD}} F_i + \beta_2^{IBD} X_i + \beta_4^{IBD} Prod_i + \epsilon_i^{IBD}\ (5a)$$

$$VPs\ in\ IMD:\ Comp_i^{IMD} = \beta_0^{IMD} + \boldsymbol{\beta_1^{IMD}} F_i + \beta_2^{IMD} X_i + \beta_4^{IMD} Prod_i + \epsilon_i^{IMD}\ (5b)$$

$$VPs\ in\ Securities:\ Comp_i^{SEC} = \beta_0^{SEC} + \boldsymbol{\beta_1^{SEC}} F_i + \beta_2^{SEC} X_i + \beta_4^{SEC} Prod_i + \epsilon_i^{SEC}\ (5c)$$

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168. While these equations may look complex, they illustrate a basic point: that by modeling each division separately, each gender coefficient (the colored term)—and each other coefficient—is allowed to vary by division. This approach makes sense because, as I show in Section 3, the challenged processes operate separately *at least at that level* and so it is possible that different factors have different weights in each division. As I will explain in more detail below, there are statistical tests that allow us to evaluate whether this is the case, *i.e.*, whether it is necessary to model compensation in the form of the Equations 5a-5c. These tests evaluate whether the coefficients across divisions for variables are equal: e.g., we can test whether the coefficient on female is equal across divisions: $\beta_1^{IBD} = \beta_1^{IMD} = \beta_1^{SEC}$; and we can test whether all the coefficients are jointly different across divisions. By failing to test whether these coefficients are equal, Prof. Farber **assumes** that there exists a common impact across all members of the class, regardless of division.

4.2.2. *Testing whether the alleged bias is common across units within GS*

169. As noted above, there is a formal statistical test one can implement to directly test whether Prof. Farber's approach of pooling all divisions and Business Units together into a single regression model that estimates a gender coefficient (i.e., gender gap) is appropriate. The test is often referred to as a "Chow test," which is a specific type of "F-test."[216] To help understand how the F-test works, it is helpful to discuss a simple example.

170. Consider GS's 360 review process for Associates. As noted above, Prof. Farber's uses a single regression to model the challenged processes that pools together professionals from all three divisions ("the pooled model"). An alternative method is to run *separate* models for each division ("the subgroup model"). An F-test allows the researcher to directly test which of these two different models fits the data better. In particular, if the subgroup model fits the data significantly better than the pooled model (i.e., the subgroup model has significantly more explanatory power than the pooled model), the F-test will

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[216] An F-test is a statistical test of a linear combination of regression coefficients. For example, an F-test could be used to determine the likelihood that two or more regression coefficients are equal. The Chow test is a specific F-test that is used to determine if the set of regression coefficients across subsets of the data are equal. In this case, I test whether the set of regression coefficients are equal across divisions. For a general overview of F-tests, see Robert S. Pindyck and Daniel L. Rubinfeld, *Econometric Models and Economic Forecasts*, Fourth Edition, (Boston, MA: Irwin/McGraw-Hill, 1998), pp. 133–135, or James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Third Edition Update, (Pearson, 2015), pp. 222–226.

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indicate that (i.e., it will "reject" that the pooled model is the more appropriate model).

171. The description of the challenged processes in Section 3 indicated that 360 reviews and manager quartiling are carried out by different decision makers in different divisions, and therefore one should not assume that the coefficient on gender, or any other variable, is the same across divisions in either the 360 review or manager quartiling regressions. In simple terms, the F-tests allow a researcher to "ask the data" whether Prof. Farber's pooled model or the subgroup model I present better reflect actual patterns in the dataset being analyzed.

172. I understand that the F-test was a subject of discussion during the class certification stage of this case. Thus, I want to make a few points about why the test is relevant before employing it in the remainder of my report.

173. **First**, the F-test is a standard analytical tool regularly used by economists. Virtually every textbook in econometrics includes an explanation of the concepts that underlie the F-test (or Chow test).[217] It is also a commonly used statistical technique for addressing the question of commonality in class action litigation: For example, a treatise from the American Bar Association on the role of econometrics in litigation specifically identifies the F-test (or Chow Test) as a "standard statistical test" that can be used "to determine whether the effect of an alleged conspiracy should be estimated separately for two or more potential subgroups."[218]

174. **Second**, when relying on an F-test test, an important consideration is whether the results of the test are consistent with the underlying facts about the

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[217] The F-test is an extremely common and well-accepted test statistic in statistics and econometrics. See, for example, Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, Fifth Edition, (Mason, OH: South-Western Cengage Learning, 2012), pp. 143–149; Robert S. Pindyck and Daniel L. Rubinfeld, *Econometric Models and Economic Forecasts*, Fourth Edition, (Boston, MA: Irwin/McGraw-Hill, 1998), at pp. 133–135, or James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Third Edition Update, (Pearson, 2015), pp. 224–226. An F-test is a statistical test regarding linear combinations of regression coefficients. One example of such a statistical test is a test for the hypothesis that certain regression coefficients are all equal to a particular value (e.g., zero). A Chow test is a particular application of an F-test. In a Chow test, the researcher performs an F-test to determine whether all of the regression coefficients are the same within two or more subgroups of the data.

[218] American Bar Association, "Applying Econometrics to Address Class Certification" in *Econometrics: Legal, Practical and Technical Issues*, Second Edition, (Chicago: ABA Publishing, 2014), p. 358 ("Standard statistical tests can be applied to test the stability of coefficients among subgroups of customers, products, time, geographies or other subsamples, and to determine whether it is appropriate to pool potential subgroups when estimating the average effect of the alleged conspiracy. For example, a Chow test can be implemented to determine whether the effect of an alleged conspiracy should be estimated separately for two or more potential subgroups of customers, products, or periods.").

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decision process one is analyzing. That is the case here. The statistical and declarative evidence presented in Section 3 indicates that the various processes at issue in this case are implemented by different decision makers evaluating different factors across the three divisions. The facts of the case (and the nature of the allegations—that there is a *common* gender gap) require one to test whether there are differences in the gender gap across sets of decision makers; the results of that test below corroborate the factual evidence.

175. **Third**, I understand that Plaintiffs have previously asserted that running regression analyses within sub-units of the firm (like division or Business Unit) is somehow unreliable because the smaller sample size within those units makes it harder to detect a statistically significant gender gap.[219] As a result, Plaintiffs claim that even if a gender gap truly exists, analyses run for different divisions or decision-making units within GS will not detect the gap because there is not enough data within the smaller subgroups.[220] There are several reasons why this argument is not a concern for the specific F-tests I will run in this report:

- Small sample sizes within sub-units can reduce the precision of regression estimates, making it *more difficult* for the F-test to detect differences across the divisions.[221] However, as I will show below, my F-tests *do* find statistically significant differences across divisions, *even with supposedly "small" sample sizes*. Thus, to the extent that Plaintiffs advance concerns related to sample size, my F-tests are robust to such concerns.

- Plaintiffs' claim that running each regression model by division or will somehow mask the "true effect" of gender cuts in both directions. In particular, if a researcher *does not* divide the data into subgroups when there are, in fact, factual and statistical reasons for using different models for each subgroup, the researcher will reach the wrong conclusion by assuming a single model can produce reliable results for all decisions when it cannot. That is precisely why the F-test is so

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[219] Second Expert Rebuttal Report of Henry S. Farber, May 19, 2014, p. 2 ("In fact, Dr. Ward's study is constructed in such a way that Dr. Ward should not expect to see '… a significant percentage of the analyses yield adverse outcomes that were statistically significant …' even in the presence of systematic discrimination against women. The flaw in Dr. Ward's procedure results from the small size of many of his business unit groupings."); Expert Rebuttal Report of Henry S. Farber, January 28, 2014, p. 50; Expert Rebuttal Report of Henry S. Farber, July 29, 2014, pp. 17–20. See also Class Cert Hearing, October 22, 2014, pp. 52–54.

[220] See footnote 219.

[221] Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, Fifth Edition, (Mason, OH: South-Western Cengage Learning, 2012), p. 146.

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important. It is a formal test that allows the data to "tell" the researcher whether to run the same model across different groups of decision makers.[222] As detailed in Section 3, there are clear factual reasons to run different models by, for example, division. If I were to ignore those facts and estimate a single model (as Prof. Farber does), I would "mask" the fact that the gender gap is not common, and reach the incorrect conclusion that there is a single, common gender gap.[223]

176. **Fourth**, I understand that, instead of implementing the Chow Test, which tests whether the whole model differs across subgroups, Plaintiffs have focused simply on whether the effect of gender differs across some subgroups.[224] This approach is incorrect. A basic tenet of econometrics is that in any regression model, the reliability of the estimate of any coefficient—like the coefficient on gender—depends on *all* of the control variables being specified properly.[225] Thus, if a full Chow Test indicates that the *entire* regression model differs across divisions, running a model that pools across divisions and ignores the differences in the effects of other control variables across divisions will generate an unreliable (biased) estimate of the gender gap.

177. However, implementing the Chow Test generally requires larger sample sizes than implementing the narrower F-test identified by Plaintiffs. Instead of testing if all coefficients in a model are equal across relevant decision making units, this narrower F-test focuses only on whether the gender coefficient is the same across relevant decision making units. In this report, I use the Chow Tests wherever possible (i.e., subgroup analyses at the division level), and use the more narrow F-test when analyzing smaller subgroups like Business Unit.[226] As

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[222] William Bielby and Pamela Coukos, "'Statistical Dueling' with Unconventional Weapons: What Courts Should Know About Experts in Employment Discrimination Class Actions," Working Paper, October 25, 2006, pp. 1–61 at p. 57 ("A statistical test of interactions between the binary variable for gender and the binary variables for subunits provides a formal test of whether effects are consistent across subunits..."). Also see published version of Bielby and Coukos for a table demonstrating the results of testing for effects across subunits (William Bielby and Pamela Coukos, "'Statistical Dueling' with Unconventional Weapons: What Courts Should Know About Experts in Employment Discrimination Class Actions," *Emory Law Journal*, 56(6), 2007, pp. 1564–1612 at p. 1605).

[223] For example, the sign and significance of the estimated gender gaps may not be common across divisions according to separate regressions by division. Even so, a regression that pools divisions would report the average gender gap across divisions, masking the underlying heterogeneous gender gaps.

[224] Expert Rebuttal Report of Henry S. Farber, July 29, 2014, ¶¶ 40–41, Tables R1 and R2. Prof. Farber tests only whether the gender gap in compensation is constant across Dr. Ward's subgroups, and concludes they are not. Prof. Farber does not test whether the models are common across subgroups.

[225] Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, Fifth Edition, (Mason, OH: South-Western Cengage Learning, 2012), p. 304. See also James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Third Edition Update, (Pearson, 2015), pp. 321–322.

[226] The narrow F-test is implemented by pooling all of the data together, interacting the gender variable with a set of dummy variables for the subgroups of interest, and then testing whether the coefficients on the interaction terms between gender and the subgroup variable (i.e., the gender gap) are the same across Business Units.

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noted above, Plaintiffs may argue that this analysis is somehow unreliable because of the sample size within these smaller subgroups; but as I show below, for both the full Chow Tests and, when not feasible, the narrower F-tests I run, the sample sizes are large enough for the tests to reject the null hypothesis of a common gender gap.[227]

178. It is also worth noting that this narrower F-test is a test recommended in a research paper cited by opinions in this case in support of Plaintiffs' arguments regarding the propriety of pooling regression analyses across divisions and Business Units.[228] Specifically, in a paper by Bielby and Coukos, the authors assess Plaintiffs' concern that subgroup analysis can mask a statistically significant gender gap by splitting data into smaller groups where statistical significance is harder to detect.[229] In that paper, the authors create three simulations of pay data for a firm with employees across multiple offices. The simulations are constructed as follows:

1. A gender gap that is identical across all offices;
2. A gender gap that differs across offices, but that is always adverse to women;
3. No gender gap in two thirds of offices and a negative gap in the other third—i.e., the gender gap is not common, but an average gap could be detected if the data were pooled.

179. The authors find that the narrow F-test correctly differentiates between these simulations. Specifically, the test is able to correctly identify a common gender gap in simulations 1 and 2, where there is an adverse gender gap in all offices. The test is also able to confirm that the apparent gender gap in simulation 3 is not common across offices, even though a regression pooling

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[227] To further ensure that my results are robust to concerns regarding small sample sizes, I have run sensitivity analyses where I remove from my analyses the smallest Business Units. I find that the F-tests continue to reject the null hypothesis that the gender gaps are the same across Business Units. See backup to Exhibit 22, Exhibit 25, and Exhibit 37.

[228] Memorandum & Order on Motions to Exclude Expert Testimony, March 10, 2015, p. 19 ("They [Bielby and Coukos] generated theoretical earnings reflecting a gender gap of 11 percent across all offices within a hypothetical firm. But when separate regressions are run for each office, this gap in pay apparently disappears. … Dr. Farber's decision to aggregate data, then, was reasonable both in light of the evidence that Goldman Sachs applies common performance measures that influence pay and promotion across business units and in light of the statistical pitfalls of disaggregation."), in which the opinion is referring to William Bielby and Pamela Coukos, "'Statistical Dueling' with Unconventional Weapons: What Courts Should Know About Experts in Employment Discrimination Class Actions," October 25, 2006, pp. 1–61 at p. 31.

[229] William Bielby and Pamela Coukos, "'Statistical Dueling' with Unconventional Weapons: What Courts Should Know About Experts in Employment Discrimination Class Actions," October 25, 2006, pp. 1–61 at p. 31); Expert Rebuttal Report of Henry Farber, filed on January 28, 2014, ¶ 137.

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over the offices *would* find and average gap.[230] In fact, this is exactly what I find using the F-tests below: the test confirms that the gender gap is not common across subunits, even though Prof. Farber's pooled regression finds an average gap.

4.2.3. *Depiction of gender bias in pay for individual professionals*

180. In addition to using F-tests to test whether the alleged gender bias that Prof. Farber measures is consistent across different subgroups of decision makers within GS, Prof. Farber's regression results contain information useful to understanding whether the alleged gender bias is consistent across *individual* professionals at GS. Below I explain the statistical methodology I use to explore this question in my report.

181. As detailed above, regression models like Prof. Farber's estimate a "gender coefficient" that reflects **the average difference** in outcomes between men and women. The same regression models can also be used to calculate the difference between each **woman's individual pay** and the pay of a "comparable male," based on the control variables in the regression. In Exhibit 20, I illustrate this concept for named Plaintiff Allison Gamba.

182. The dark blue bar on the left represents Ms. Gamba's actual compensation of ███████. The light blue bar represents her compensation as predicted by my compensation model,[231] and it shows her predicted pay to be ███████. The third bar represents her predicted compensation in light blue, plus the gender compensation gap in green. The total of these bars represents the predicted compensation of a comparable male professional with the same characteristics as Ms. Gamba, based on the regression model. The predicted compensation of a comparable male is derived by taking all of the variables we have about Ms. Gamba in the regression model (tenure, Business Unit, function, etc.), and using the coefficients from the regression model for all of those variable to

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[230] William Bielby and Pamela Coukos, "'Statistical Dueling' with Unconventional Weapons: What Courts Should Know About Experts in Employment Discrimination Class Actions," October 25, 2006, pp. 1–61 at p. 57 ("A statistical test of interactions between the binary variable for gender and the binary variables for subunits provides a formal test of whether effects are consistent across subunits.... Table 4 shows that when there is radical heterogeneity -- no disparity in some offices and a huge disparity in others, the interaction test is indeed statistically significant, rejecting the hypothesis that the gender disparity is the same in every office."). Table 4 is also shown in the published version (William Bielby and Pamela Coukos, "'Statistical Dueling' with Unconventional Weapons: What Courts Should Know About Experts in Employment Discrimination Class Actions," *Emory Law Journal*, 56(6), 2007, pp. 1564–1612 at p. 1605).

[231] See Exhibit 30 for a detailed explanation of the corrections I make to Prof. Farber's compensation regression model.

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predict what **a man with those exact same characteristics** would be paid. There are two patterns to note in this example:

- First, Ms. Gamba's actual compensation (the dark blue bar on the left) is substantially higher than the compensation the regression predicts for a comparable male (the bar on the far right).

- Second, even though Ms. Gamba earns over ▇▇▇▇▇ more than a comparable male, Prof. Farber's methodology concludes that she was subject to discrimination because the *average* difference between actual compensation and compensation of a comparable male across all class members is negative.

Source: Goldman Sachs Data Production

Note: Predicted Compensation and Predicted Compensation of Comparable Male are based on a regression model of compensation. The regression specification incorporates the corrections I make to Professor Farber's compensation model; see Exhibit 30 for a full list of corrections. The regression specification includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, and whether a professional was placed in the top manager quartile. To calculate the Predicted Compensation of Comparable Male, the coefficient on the female indicator variable is first subtracted from Allison Gamba's predicted log compensation. This adjusted log compensation is then exponentiated and multiplied by the average exponentiated residual in order to calculate the Predicted Compensation of Comparable Male. To calculate the Predicted Compensation, the unadjusted predicted log compensation is exponentiated and multiplied by the average exponentiated residual. The dollar residual is calculated as the difference between the Actual Compensation and the Predicted Compensation. The dollar Female-Male Compensation Gap is calculated as the difference between the Predicted Compensation and the Predicted Compensation of Comparable Male.

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183. Exhibit 20 is connected to the overall regression results in the following way: if we (1) calculate the gap in pay between each woman's actual pay and the pay of the corresponding "comparable male" professional, and (2) take the average across all of those individual gaps, we would arrive at the gender coefficient from the underlying regression model.[232] Indeed, Prof. Farber points out this feature of his regression models in his own report.[233]

184. In later sections of this report, I apply the framework in Exhibit 20 to Prof. Farber's 360 review regression and his compensation regression as a way to analyze how his estimate of the average gender coefficient compares to the gender gap for individual class members. In fact, Prof. Farber's approach of focusing on the average gender coefficient masks a significant amount of variation across individual class members. Many class members received 360 review scores or PATC substantially higher than comparable men at GS.

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[232] This relationship technically holds when the differences are expressed in logarithms, and my conclusions hold when analyzing differences between actual log compensation and the log compensation of comparable males. See backup to Exhibit 20.

[233] Farber Report, ¶¶ 55–56 ("The coefficients of the model are estimated using multiple regression analysis, and these estimated coefficients are used to compute a prediction of pay for each worker based strictly on the factors included in the model. Estimates of the unmeasured factors are then computed as the difference between the actual pay level and the predicted pay level. This difference is called the residual. If pay is determined in a non-discriminatory fashion, then these residuals will not be systematically related to the sex of the worker. If there is a systematic relationship such that women are paid less, on average, than predicted by the factors included in the model, then I would conclude that the analysis provides statistical evidence of discrimination.").

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5. MY ANALYSIS SHOWS THAT THE DATA REJECT PLAINTIFFS' CLAIM OF SYSTEMIC GENDER BIAS IN THE 360 REVIEW PROCESS, THE ASSIGNMENT OF MANAGER QUARTILES, AND PROMOTIONS

185. In this section, I present my analysis of the alleged gap in the challenged processes. As detailed throughout this report, Plaintiffs' allegations of disparate impact center on alleged gender disparities in these three processes. Thus, the first step in testing Plaintiffs' claims of harm is assessing whether GS's 360 review scores, manager quartiling, and cross-ruffing decisions do, in fact, exhibit systemic, common bias against female professionals.

186. As explained in Section 4, despite the fact that GS's review processes are implemented in a decentralized fashion whereby each class member is evaluated by a different set of decision makers, Prof. Farber runs a *single* regression model for VPs and a *single* model for Associates, effectively *assuming* there is a single gender gap for each corporate job title across all Business Units and decision makers. That is, Prof. Farber makes no attempt to *test* whether the alleged gender gaps in the challenged processes are, in fact, common across the many different decision makers that implement each review process. I have shown that such a model is **methodologically incapable** of testing Plaintiffs' claim of systemic bias. By its design, such a model only reports an average gender gap, and Prof. Farber *assumes* that this single gender gap applies equally to all professionals in GS. I begin in Section 5.1 by presenting the proper approach for *testing* whether the alleged gender gaps in the challenged processes are, in fact, common.

187. In Sections 5.1 and 5.2, I implement such tests. Specifically, for both the 360 review and manager quartiling processes, I estimate a corrected version of Prof. Farber's regression separately by division. Then, I assess whether the gender gaps in these corrected models are statistically significant and negative for each of the three revenue producing divisions at issue in this case and for both VPs and Associates. They are not. I also analyze whether, within each division, the alleged gender gaps are statistically significant and negative. For the 360 review process, I also review the regression estimates of alleged bias in 360 reviews at the individual level for each class member. Across all of these tests and analyses, I find there is *not* a statistically significant, negative, systemic gender gap in 360 review scores or manager quartiling.

188. In Section 5.3, I turn to my analysis of promotions. In that section, I briefly summarize GS's process for promoting Vice Presidents to EMDs, as well as

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flaws in Prof. Farber's regression model for analyzing promotions. I then present my updated statistical analyses that correct for Prof. Farber's flawed approach. I find no evidence that GS's promotion process disadvantages women. In fact, I find that women VPs are promoted at statistically significantly higher rates than men in Securities.

5.1. The data reject Plaintiffs' claim of common gender bias in 360 review scores

189. Given the decentralized implementation of GS's review processes, the proper way to test Plaintiffs' claim of systemic bias is to examine the alleged bias across *different sets of decision makers* at GS. For my analysis of 360 review scores, I consider two different groupings of decision makers: division and Business Unit.

5.1.1. *The alleged gender gap in 360 review scores varies across divisions and over time*

190. I begin my analysis of the 360 review process by analyzing whether there is a common gender gap in 360 review scores that is statistically significantly adverse to women across (a) all three divisions, (b) the two different numeric 360 review frameworks used during the class period in which Prof. Farber alleges to find bias (he finds no gender gap during the third OMR framework), and (c) the two broad corporate job titles at issue (Associate/Junior Banker and VP/Senior Banker). This approach yields 12 different subgroups of professionals across which I can examine average gender differences in 360 review scores. This approach is based on several important facts detailed in Section 3:

- First, the factual record makes clear that the 360 review process is implemented by different sets of reviewers across different divisions and Business Units, who conduct individualized evaluations of each class member in the context of her role. As noted above in Exhibit 16, the data produced in this case show there is very little overlap of 360 reviewers across divisions.[234]

- Second, GS used three frameworks for the 360 review processes during the relevant class period—a five-point scale pre-2010, a nine-point scale

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[234] As discussed above, typically more than 88 percent of reviewers only reviewed employees in a single division in any given year during the class period (Workpaper 7); and on average, each class member had less than one reviewer from outside her division (Workpaper 8).

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from 2010 to 2015, and the OMR score from 2016 onward. Further, the decision makers within each division also changed substantially over time. For example, as shown in Exhibit 18, more than half of the 360 reviewers for VPs in the Securities division in 2008 were no longer reviewers by 2015. Such patterns indicate that there were distinct sets of decision makers under the three different frameworks.

Overall, Prof. Farber agrees that the three 360 review frameworks need to be analyzed separately, and he finds no evidence of bias in the OMR framework. However, other shortcomings of his analyses remain. While I run 360 review regressions for 12 subgroups (by division, title, and 360 review framework), Prof. Farber runs 360 review regression for only six subgroups (by corporate job title and 360 review framework), which I show incorrectly pools data for all three divisions.

- Third, the lack of overlap in reviewers across divisions and the changing set of reviewers over review frameworks mean that there is very little overlap in decision makers between the 12 combinations of division, corporate job title, and framework. On average, combinations of division, corporate job title, and review framework only share 12 percent of reviewers.[235]

191. An additional flaw in Prof. Farber's regression is the omitted variable bias that occurs when he fails to include production variables in his 360 review models.

192. In Exhibit 21, I present the estimated gender gaps for the OMR period and the 12 different subgroups for the numeric 360 review frameworks using my regression model, which is based on a corrected version of Prof. Farber's 360 regression that includes production variables.[236] Each entry reports the gender gap for women as compared to men for that division, corporate job title, and review framework. As the table makes clear, there is no evidence of a common gender gap in review scores. Prof. Farber finds no bias in the OMR period, and I

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[235] See Workpaper 13.

[236] See Appendix C for a complete list and description of the variables in both my and Prof. Farber's regression models, as well as a description of my baseline regression sample (dubbed "Baseline Regression Sample" in exhibit notes). Unless otherwise noted, the regression sample begins in 2005 and consists of Associates and Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, had non-missing manager quartile, had non-missing 360 review score / OMR, and were not self-sustaining Private Wealth Advisors.

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show that two-thirds of the remaining groupings (8 out of 12) show no statistically significant negative gap.[237]

193. In summary, consider the results by review framework and thus by time period. In the current framework that uses OMRs (2016–2018), Prof. Farber finds no bias for any class members. In the review framework from 2010–2015, I show that gender gaps are not statistically significant for VPs/Senior Bankers in any division, or for Associates in IMD or Securities. In the pre-2010 framework, the gender gap is statistically insignificant for Associates in IMD and for VPs and Senior Bankers in IBD and IMD. **Looking across all three frameworks together, 71 percent of class members are in divisions-corporate job title groups that exhibit no negative and significant gender gap in review scores.[238]** Overall, this implies that when a corrected regression model is estimated, there is no pattern of common bias.

Exhibit 21

There is no common gender gap in 360 review scores: estimated gender gaps from my corrected regression model

| Models | Investment Banking | | Investment Management | | Securities | |
	Junior Bankers	Senior Bankers	Associates	Vice Presidents	Associates	Vice Presidents
1. OMR: 2016 to 2018	Prof. Farber Finds No Gender Gap					
2. 360: 2010 to 2015	-0.06*	-0.05	-0.01	-0.03	-0.01	-0.02
3. 360: pre-2010	-0.10*	-0.05	-0.01	-0.01	-0.04*	-0.03*
Share of Class Members	15%	6%	11%	28%	16%	25%
Number of Class Members	1,257	485	902	2,364	1,350	2,065

Source: Goldman Sachs Data Production

Note: "*" indicates statistical significance at the 5% level. Standard errors are clustered at the individual professional level. The sample consists of Associates and Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, had non-missing manager quartile, had non-missing 360 review score / OMR, and who were not self-sustaining Private Wealth Advisors. The model controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, and production. Appendix C contains detailed descriptions of the production variables. Tenure is time in position, time in position squared, time at GS, and time at GS squared. For Junior Bankers in Investment Banking, tenure also includes years as a Junior Banker.
Row 2 displays the female/male difference in 360 review score points received on the 1–9 scoring scale.
Row 3 displays the female/male difference in 360 review score points received on the 1–5 scoring scale. All models begin in 2005 due to limited data.

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[237] There is also no significant gender gap in 360 review scores or manager quartiles among SSPWAs. See Workpaper 14 and Workpaper 15. As noted above, I study SSPWAs separately since their compensation is entirely formulaic.

[238] See backup to Exhibit 21.

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194. Prof. Farber pools his regression analysis of 360 review scores across divisions, assuming a common model and common gender gap across divisions. However, as I explained in Section 4.2.2, one does not have to speculate about whether or not it is appropriate to pool the divisions in a regression: one can test whether or not the divisions should be analyzed separately. To do this, I run the commonly used statistical test I detailed in Section 4 called the "Chow test" (a type of "F-test").[239] As explained in Section 4, I run this test in order to directly test whether Prof. Farber's approach of assuming that the 360 process is the same across all divisions and time periods is consistent with the data. These tests reject Prof. Farber's assumption that the 360 review scores should be analyzed together across all divisions.[240] Rather, they show that modeling the 360 review process at the division level is more appropriate.

5.1.2. *The alleged gender gap in 360 review scores varies across Business Unit*

195. Another way to test whether there is evidence of systemic bias in the 360 review process is to assess whether the gender gaps in the 360 review process are the same across different Business Units. Professionals who work in different Business Units perform different jobs, are evaluated in the context of those different jobs, and receive reviews from different collections of reviewers. As explained in Section 3, there is limited overlap in reviewers across Business Units. Each Business Unit has a <u>unique</u> set of reviewers associated with it, and any pair of Business Units within a year and corporate job title have less than one percent of reviewers in common.[241] In other words, each Business Unit provides a proxy for a unique set of reviewers in the 360 process. Given these facts, examining gender gaps across different Business Units is another way to directly test whether the gender gap is common across class members.

196. If GS's review processes impose a consistent bias against class members, we should see common gender gaps across Business Units. If, on the other hand, different sets of reviewers implement the processes in different ways, and there is no systemic bias against women, we would expect to see statistically

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[239] An F-test is a statistical test of a linear combination of regression coefficients. For example, an F-test could be used to determine the likelihood that two or more regression coefficients are equal. The Chow test is a specific F-test that is used to determine if the set of regression coefficients across subsets of the data are equal. In this case, I test whether the set of regression coefficients are equal across divisions. For a general overview of F-tests, see Robert S. Pindyck and Daniel L. Rubinfeld, *Econometric Models and Economic Forecasts*, Fourth Edition, (Boston, MA: Irwin/McGraw-Hill, 1998), pp. 133–135, or James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Third Edition Update, (Pearson, 2015), pp. 222–226.

[240] See Workpaper 16.

[241] See Workpaper 9.

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significant differences in the gender gaps across Business Units. Importantly, the data allow us to test directly which scenario actually exists at GS.

197. In Exhibit 22, I present the results of testing whether the estimated gender gaps in 360 reviews differ across Business Units for Associates and Junior Bankers (the results are similar for VPs and Senior Bankers).[242] Specifically, I report estimated gender gaps in 360 review scores by Business Unit for Associates and Junior Bankers, based on a corrected version of Prof. Farber's regression model of the 360 review after adding production metrics.[243] Each bar in Exhibit 22 represents the estimate of the gender gap in 360 review scores for a given Business Unit. Bars above zero represent Business Units where female employees receive higher 360 review scores than men in the same Business Unit, holding fixed all of the variables included in the model. Bars below zero represent Business Units whose female employees receive lower 360 review scores than men in the same Business Unit. Dark bars indicate that the gender gap in 360 review scores is significantly different from zero.

198. Exhibit 22 displays that there is large variation in the size of the alleged gender gaps, with some positive, some negative, and many statistically indistinguishable from zero.[244]

199. In total, across all Business Units, 77 percent of women Associates and Junior Bankers are in in Business Units with no negative and significant gender gap. Indeed, three percent are in Business Units with positive and significant gaps that *favor* women. This pattern is broadly similar for women VPs and Senior Bankers, 91 percent of whom are in Business Units with no negative and significant gender gap, and four percent in Business Units with gaps that significantly favor women. Across the entire class, 85 percent of class members are in Business Units with no negative and significant gap. [245]

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[242] For illustrative purposes, the exhibit displays results for Associates and Junior Bankers; similar results for VPs and Senior Bankers are included in the exhibit backup.

[243] In order to increase sample size for the regression and within each Business Unit, I pool the data across divisions and time periods for this analysis. I then include an interaction between gender and Business Unit to estimate a separate effect of gender for each Business Unit. I include year fixed effects to account for level differences in average scores over time. The distribution of scores is similar under the 5-point and 9-point scales, so one can interpret the coefficient on gender similarly for both the pre-2010 and 2015-2010 360 review scoring frameworks.

[244] For detailed results by Business Unit, see Appendix E.

[245] See backup to Exhibit 22.

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Exhibit 22

There is no common gender gap in 360 review scores

Associates and Junior Bankers by Business Unit, 2005 – 2015

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male 360 Score Difference are displayed. The regression specification controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male 360 Score Difference refers to the difference between male and female 360 scores implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. Statistical significance is determined at the 5% level. Standard errors are clustered at the individual professional level. Analysis uses Baseline Regression Sample.

200. One particularly notable pattern in Exhibit 22 is that women received 360 review scores that were statistically significantly higher than men in several Business Units. For example, the Fixed Income and IMD Strats Business Units in IMD had statistically significant gaps of 0.14 and 0.20, respectively, in favor of female Associates. These Business Units had 102 person-year observations and 67 person-year observations, respectively. A similar pattern holds for VPs: for example, the Americas Institutional Business Unit in IMD, with 283 person-year observations, had a statistically significant gap of 0.08 in favor of female VPs.[246]

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[246] See Appendix E.

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201. These results, of course, refute the claim that any bias in the 360 review process against women is common. Further, it highlights a key methodological flaw in Prof. Farber's model. Under Prof. Farber's methodology, a significant gap that favors women implies that reviewers in those Business Units are **discriminating against men,** even as reviewers are allegedly discriminating against women in other BUs.[247] This is an unlikely explanation: A more reasonable interpretation of such patterns is that the regression models for the 360 review process cannot control for many individualized factors that affect 360 review scores. Thus, the models will generate "gender gaps" that reflect average differences across gender in unmeasured factors, rather than any alleged, common "bias" in the review process.

202. I also conduct an F-test for each corporate job title that directly tests whether the gender gap in 360 review scores is the same across Business Units within that corporate job title.[248] The F-test I specify here ascertains whether the effect of a specific variable (i.e., being female) on an outcome of interest (i.e., 360 review score) is sufficiently different across subgroups (i.e., Business Units) such that analysis of that variable must be analyzed separately by subgroup. The F-tests statistically reject Plaintiffs' assertion that the gender gap in 360 review scores is common across Business Units. Instead of a common effect, the data show substantially different effects across Business Units, and the F-test tells us that these differences are statistically significant.[249] This refutes a core assumption of Prof. Farber's model and Plaintiffs' claims.

5.1.3. *The alleged gender bias in 360 reviews varies across individual class members*

203. Using my corrected version of Prof. Farber's 360 review regression, I can also examine how *individual* class members' 360 reviews compare to those of comparable male professionals. As detailed in Section 3, each individual professional chooses their own 360 reviewers, resulting in nearly every professional being reviewed by a unique set of reviewers. Therefore, even if one

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[247] For example, Prof. Farber writes that "Economists define sex discrimination in pay to be differences in pay between men and women that cannot be explained by differences in personal characteristics like education and work experience or differences in the type of work they perform." See Farber Report, ¶ 50.

[248] See backup to Exhibit 22.

[249] As I also mention above, to further ensure that my results are robust to concerns regarding small sample sizes, I have run sensitivity analyses where I remove the smallest Business Units from my analysis. I find that the F-test continues to reject the null hypothesis that the gender gap is the same across Business Units. See backup to Exhibit 22.

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professional was subject to gender bias by his or her reviewers, that does not mean that other professionals would have also been subject to gender bias.

204. I explore this question of whether each class member was subject to gender bias in the 360 review scores by comparing the 360 review scores of individual class members to the 360 review scores of comparable male professionals as predicted by my corrected regression model. Specifically, the regression model allows me to take any given female professional, hold all her characteristics fixed, then "turn off" any alleged effect of gender and predict her 360 review score. This exercise then yields the 360 review score that the female professional would have been expected to receive if she were a comparable man with all of her same characteristics (education, tenure, corporate job title, etc.).[250] I can then subtract the score of this hypothetical male counterpart from each woman's actual 360 review score from, allowing me to assess whether her actual score was higher or lower than her predicted score if she were a man.

205. **Top Panel.** In Exhibit 23, I present a hypothetical example that demonstrates how the data might look if Plaintiffs' theory were correct. I plot (a) each hypothetical female VP's 360 review score on the Y-axis, (b) each hypothetical female VP's *predicted* 360 review score if she were male on the X-axis, and (c) a 45-degree line. Dots below the 45-degree line represent women who received a lower 360 review score than a similarly situated male would have been expected to received. If Plaintiffs' allegations of systemic discrimination were true, the dots would fall below the 45-degree line. In other words, under Plaintiffs' theory, one would expect women to receive lower 360 review scores than comparable men.

206. **Bottom Panel.** Next, I turn to GS's actual data, using VPs in Securities in 2007 as an example. The dashed 45-dregree line represents points where a woman's actual 360 review score equals the 360 review score of her hypothetical male counterpart. Dots above the line represent women who received a 360 review score higher than what similarly situated males received.[251]

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[250] See Exhibit 23 for a description of this exercise.

[251] A helpful feature of this analysis is that the average gender gap from the regression model is exactly equal to the average difference between each woman's actual 360 review score and the 360 review score of the comparable male. Thus, the difference between each woman's actual 360 review score and the 360 review score of a comparable male effectively represents her contribution to the regression adjusted average gender gap.

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207. Consider the orange dot that is highlighted above the 45-degree line: ███████████████████████. This dot shows that ██████████ 360 review score was actually higher than the 360 review scores awarded to comparable males using my corrected regression model.[252]

208. Indeed, 48 percent of women VPs in Securities in 2007 scored better than comparable men. Broadening this analysis to look across all divisions, years, and titles, 48 percent of *all* class members received scores higher than comparable men did.[253] In other words, even though the regression model finds an average gender gap adverse to women in 360 review scores for this specific group (VPs in Securities), it also finds that ██████████ and many other class members in that group received a *higher* 360 review score than comparable men. The same pattern holds for other division-corporate job title groups. Given that each class member was reviewed by a distinct set of 360 reviewers, the pattern raises a fundamental question about Plaintiffs' claim that class member's 360 review scores were systematically impacted by bias in a common way.

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[252] Both Ms. Gamba and Mary De Luis received higher scores than a comparable male in at least one year. In her single full year at GS, Shanna Orlich received lower scores than a comparable male. I am unable to conduct a similar analysis for Cristina Chen-Oster because she left GS before the start of my analysis sample. See backup to Exhibit 23.

[253] See backup to Exhibit 23. Note that the percentages reported in text refer to the fraction of class member-year observations, not the fraction of unique class members. As a sensitivity, I also estimated the regression with Prof. Farber's model as he specified. These results are robust to the choice of model. See backup to Exhibit 23.

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Exhibit 23

Under Plaintiffs' theory, most women's actual 360 review score would be lower than that of a comparable man: hypothetical example
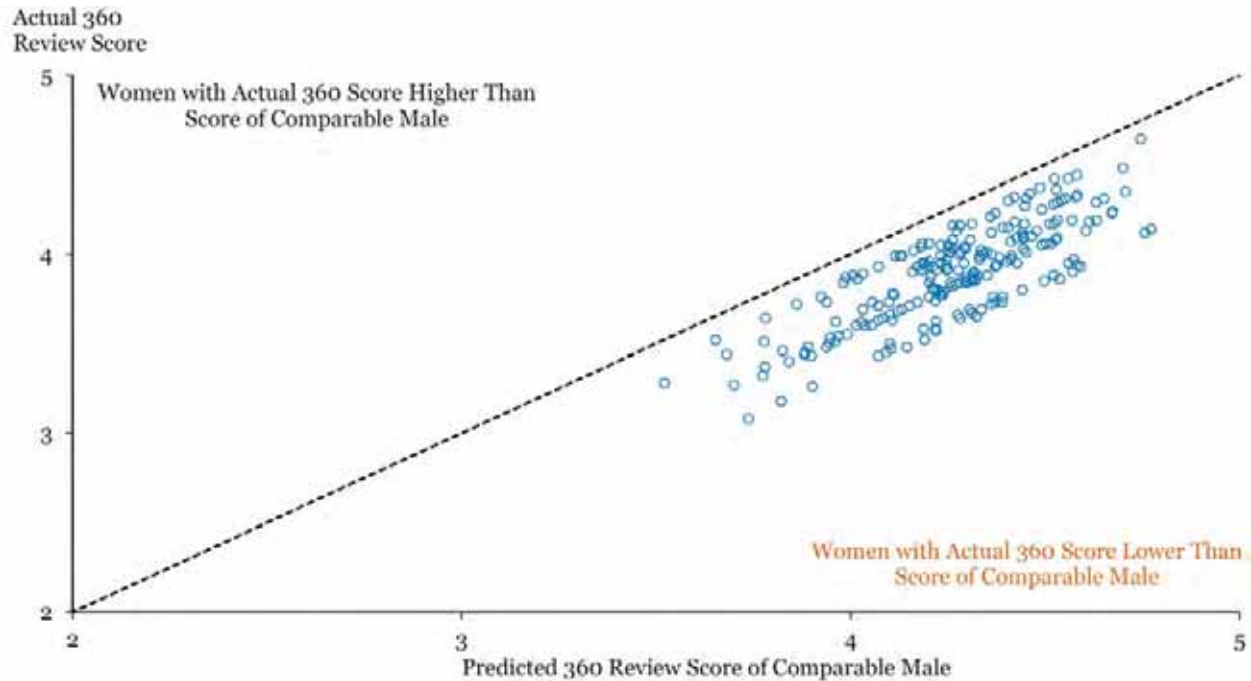
In fact, many women earn 360 review scores that vary widely from, and are higher than, the predicted scores of comparable men

Securities Vice Presidents, 2007
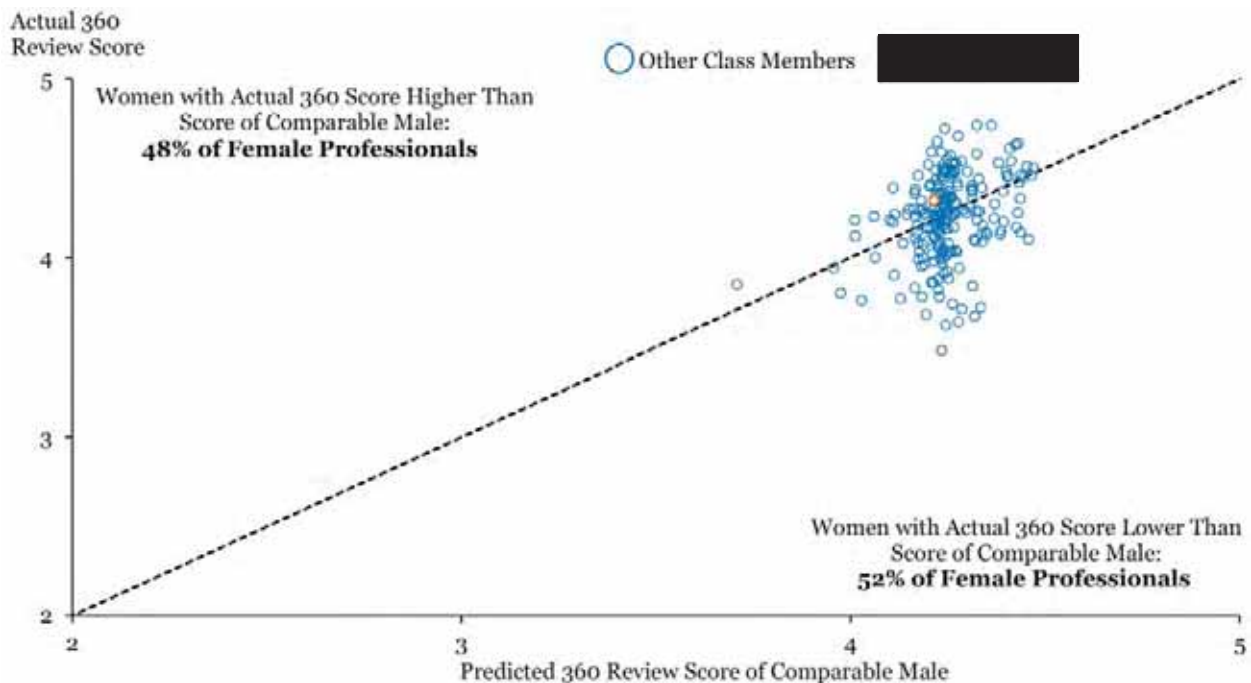
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Source: Goldman Sachs Data Production

Note: The regression controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, and production. 360 Review Score of Comparable Male is calculated by first estimating the predicted 360 review score of all professionals. The coefficient of the female control is then subtracted from the predicted 360 review score for female professionals. The model is separated by division, corporate job title, and review regime. The dashed line marks when Actual 360 Review Score and 360 Review Score of Comparable Male are equivalent. Analysis uses Baseline Regression Sample.

5.2. The data reject Plaintiffs' claim of common gender bias in manager quartiling

209. I now turn to Prof. Farber's regression analysis of the alleged gender gap in the manager quartiling process, the process by which managers assign professionals to a particular quartile based upon their performance. As noted above, Prof. Farber runs two regression models he developed—one for Associates and one for VPs. These models test whether women are less likely than men, on average, to receive the top quartile rating, controlling for variables he included in his model. Prof. Farber also separately runs his regression analysis of manager quartile for 2016 to 2018.[254] He finds no evidence of bias in the 2016 to 2018 period, so I focus on the pre-2016 period, where he alleges there is bias.

210. Similar to his analysis of the 360 review process, Prof. Farber's regression analysis of manager quartiling is not capable of testing whether the process is systemically biased against women because it ignores the decentralized implementation of manager quartiling. As I show below, when I use a corrected regression framework to directly test whether the assignment of manager quartiles is systemically biased across divisions, I find that it is not.

211. I begin my analysis by assessing whether, after controlling for relevant variables, the gender gap in manager quartiles is statistically significantly in favor of men across VPs and Associates in all three divisions. As I have detailed previously, divisions operate as distinct businesses with distinct objectives and distinct sets of decision makers that implement review processes. Thus, it is critical to *test* whether—rather than *assume* that—the gender gap in manager quartiles is common across divisions.

212. For my analysis of manager quartiling, examining gender gaps by division yields six different subgroups of class members to analyze—one for each division and corporate job title (Associate/Junior Banker and VP/Senior

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[254] Farber Report, Tables 19 and 20.

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Banker). Furthermore, I follow Prof. Farber in breaking out the pre-2016 period, since he finds no evidence of bias 2016 to 2018.

213. To analyze gender differences in quartiles, like Prof. Farber I use a probit regression model to estimate the probability a professional is placed in the top quartile. The model I estimate controls for the variables identified by Prof. Farber, plus production metrics and a professional's 360 review score.[255] If Plaintiffs' claims of systemic bias in the manager quartiling process were true, I would expect to see consistently negative gaps in the likelihood of assignment to the top quartile across divisions, job titles, and time periods.

214. As shown in Exhibit 24, I do not. From 2016 to 2018, Prof. Farber finds no significant gender differences in manager quartiling for any division or corporate job title, so there is no claim of bias for me to respond to. Prior to 2016, I find there are no significant differences in manager quartiling in any division for Associates, and there are no significant gender gaps for VPs in IMD and Securities. These patterns sharply contradict Plaintiffs' allegation that the manager quartiling process is systemically biased against women.

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[255] See Appendix C for detailed information on the variables included in my regression model of manager quartiling.

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Exhibit 24

There is no common gender gap in manager quartiling

	Gender Difference in Top Manager Quartile Placement		
	Investment Banking	**Investment Management**	**Securities**
Pre-2016			
1. Associates/Junior Bankers	-0.46%	0.51%	0.05%
2. Vice Presidents/Senior Bankers	-5.93% *	1.53%	-0.89%
2016–2018			
3. Associates/Junior Bankers	Prof. Farber Finds No Gender Gap		
4. Vice Presidents/Senior Bankers	Prof. Farber Finds No Gender Gap		

Source: Goldman Sachs Data Production

Note: The table shows the average marginal effects of being female relative to males, for females, on the probability of being placed in the top manager quartile. The regression controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, and 360 review score. "*" after the average marginal effect indicates statistical significance of the marginal effect of being female at the 5% level. Standard errors are clustered at the individual professional level. The sample consists of Associates and Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, had non-missing manager quartile, had non-missing 360 review score, and were not self-sustaining Private Wealth Advisors.

215. There are a few technical points worth discussing regarding the analysis in Exhibit 24. As noted above, I include the 360 review scores as control variables in the model of manager quartiling. I understand Prof. Farber claims that 360 review scores should not be included in the model because these variables are allegedly biased.[256] Given my analysis of 360 review scores above, I do not see any reason to exclude these important measures of performance from the analysis. There is no evidence of a common gender gap in 360 scores across division or Business Unit, and there is no evidence that the gender gaps measured by Prof. Farber's regression model reflect bias.

216. Furthermore, even if one were concerned about bias in the 360 review scores, in order to assess whether there is any _incremental_ bias in the manager quartiling process beyond the alleged bias in the 360 review scores, the manager quartiling model must contain the 360 review scores. Otherwise, the estimated effect of gender on manager quartile will itself be biased: the gender coefficient will incorrectly "pick up" any effect of gender differences in 360

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[256] See, e.g., Expert Rebuttal Report of Henry S. Farber, July 29, 2014, ¶ 28.

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reviews scores on manager quartile, potentially making it *look* like there is a gender gap in manager quartiling when there is not.

217. To give a hypothetical example, suppose that manager quartiles *only* reflected 360 review scores. In that case, there would be no scope for incremental bias in the manager quartiling process, and a regression model of manager quartiling that included 360 review scores would find no gender gap in manager quartiling. At the same time, there could be an average gender difference in manager quartiles if women received lower 360 review scores than men. In that case, a regression model of manager quartiling that did *not* control for 360 review scores would misleadingly show a gender gap in manager quartiling that is simply reflecting the gender gap in 360 review scores. Thus, it is my view that the approach of including 360 review scores in a model of manager quartiling is correct.

218. It is also important to note that, as with my analysis of 360 review scores, I ran an F-test comparing the effect of variables in the model across divisions to confirm that the data support my approach of running separate regressions by division. Specifically, I directly tested whether the data are consistent with Prof. Farber's assumption that manager quartile assignments follow the same model across all divisions, or instead follow different models for each division. The F-test rejects Prof. Farber's assumption, finding that there are, in fact, different models for each division.[257] Thus, as with my approach to 360 review scores, both the factual record and the statistical evidence support my decision to analyze manager quartiling at the division level, and to break the analysis out into two periods like Prof. Farber.[258]

219. In addition, the analysis above likely understates the lack of commonality in gender gaps in manager quartiling. As detailed in Section 3, the assignment of professionals to manager quartiles is typically done by leaders within a professional's Business Unit. Thus, even within a division, there are at least as many decision makers as there are Business Units determining manager

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[257] The test I run here (a "Wald test") is analogous to the "F-test" used in the previous sub-section, and is the appropriate analog for the probit model estimated here. I run the test using my corrected model to determine whether it is appropriate to estimate a single model of manager quartiling across all three divisions in the pre-2016 period. To be conservative, I limit my test to variables that are common across divisions. The test rejects a common model across the divisions for both Associates and Vice Presidents. I therefore run the model separately by division for these groups. See Workpaper 17.

[258] All of the points above about the importance and reliability of F-tests apply here as well.

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quartile assignments for individual professionals, which suggests gender gaps in manager quartiles likely vary by Business Unit.

220. Exhibit 25 confirms that there is, indeed, significant variation in gender gaps across Business Units. The chart shows the estimated gender gap in manager quartiling for VPs/Senior Bankers within each Business Unit in each of the three divisions (the results are similar for Associates/Junior Bankers).[259] Dark blue bars indicate Business Units with statistically significant gender differences in manager quartiling. Overall, 97 percent of VPs/Senior Bankers, and 93 percent of Associates/Junior Bankers, are in Business Units with no negative and significant gender gaps in manager quartiling.[260] Indeed, three percent of women Associates/Junior bankers are in Business Units with gender gaps that significantly favor women, and a full 11 percent of women VPs/Senior Bankers are in Business Units that significantly favor women.[261] For each corporate job title, an F-test rejects Prof. Farber's assumption that gender differences in manager quartiling are common across Business Units.[262]

221. Finally, note that many class members could not have been injured in the manager quartiling process because they received the best manager quartile possible: more than a third of class members received a top manager quartile in at least one year, and that a full 8 percent of class members received a top manager quartile in all years they are present in the data.[263] This contradicts the claim that women face common bias in manager quartiling.

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[259] For detailed results by Business Unit, see Appendix F.

[260] See backup to Exhibit 25.

[261] See backup to Exhibit 25.

[262] The Wald test I run here evaluates whether the gender coefficients in the probit model are equal across Business Units. For ease of exposition, Exhibit 25 shows the estimated average marginal effects of gender on top quartile placement in each Business Unit, rather than the estimated gender coefficients themselves.

[263] See Exhibit 69 in Appendix K.

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Exhibit 25
There is no common gender gap in manager quartiling

Vice Presidents and Senior Bankers by Business Unit, 2005 – 2015
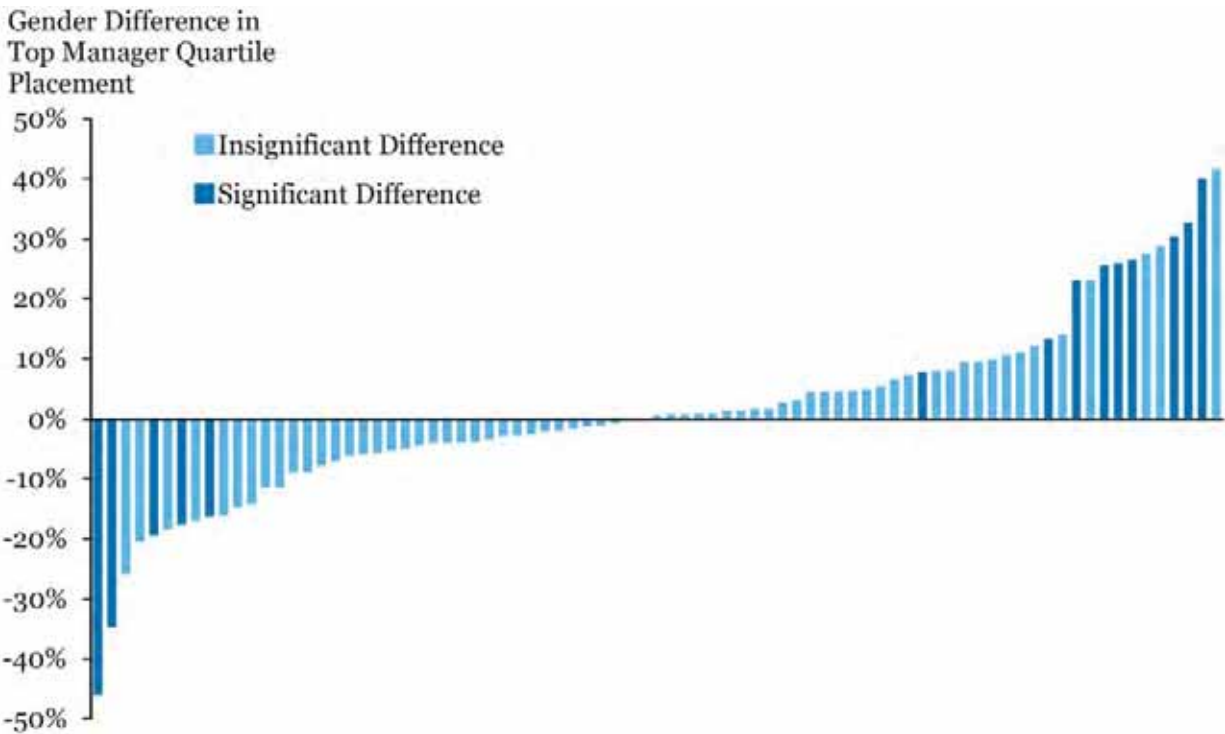
Source: Goldman Sachs Data Production

Note: Gender Difference in Top Manager Quartile Placement refers to the average marginal effect of being female relative to males, for females, on the probability of being placed in the top manager quartile. Only Business Units with both male and female professionals and an estimable average marginal effect are displayed. The regression controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, 360 review score, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Individuals with missing Business Unit are included in the regression, but not displayed. Statistical significance is determined at the 5% level. Standard errors are clustered at the individual professional level. Analysis uses Baseline Regression Sample.

5.3. The data reject Plaintiffs' claim of gender bias in promotion to Managing Director

222. As noted above, Plaintiffs allege that GS's "cross-ruffing" process for promotion from Vice President to EMD systemically disadvantages women. Plaintiffs' primary criticism is that the promotion process is "invalid and opaque."[264] Further, Plaintiffs claim that their statistical analyses show that

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[264] Plaintiffs' Class Cert Motion, pp. 11–12 ("Like the class certified in *Ellis*, 285 F.R.D. 492, the Class here challenges Goldman's invalid and opaque selection process, controlled by a small group of Goldman managers. As a result of maintaining this process, Goldman promoted 23% fewer women than would have been expected if they had been promoted at the same rate as men with the same characteristics.").

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female Vice Presidents are promoted at a statistically significantly lower rate than male Vice Presidents.[265] I address these claims in this section. Correcting Prof. Farber's models, I find no evidence of bias in the promotions process.

5.3.1. *The nomination and cross-ruffing processes are decentralized across divisions and involves many decision makers*

223. Overall, there are two steps to promotion from Vice President to EMD at GS: (1) the creation of a list of VP nominees to be considered for promotion; and (2) "cross-ruffing," during which the nominees are rigorously evaluated, and which culminates in determining a final list of promotions to EMD. As explained in detail in Section 3.2.3, GS's process for nominating and then cross-ruffing EMD candidates is decentralized and involves many actors. Both of these processes take place primarily at the divisional level, and each division has its own criteria for promotion based upon the function of each division and client demands.[266] Decisions to promote a professional to EMD take place at the division level because promotions to EMD are a permanent partnership and come with very large increases in pay—on average, the difference in PATC between VPs who are promoted and all EMDs is about $260,000.[267] In addition, revenue sources are very different across divisions, and so are the traits valued in an EMD.

224. In general, promotion from VP to EMD is rare. In each class-relevant year, fewer than 150 VPs out of between 1,266 and 2,422 total VPs receive promotions to EMD, with an average of 73 VPs promoted to EMD per year across all three divisions I analyze.[268] Promotions during the class period occurred in every year or, more recently, every other year. In Exhibit 26, I present promotions and promotion rates by year for the three divisions.[269] Note that in 2014, 2016, and 2018, there were no promotions to EMD in any division. As a result, the number of people considered for promotion are few and each nominee is considered individually.

225. The number of promotions per year that I report in Exhibit 26 differs from the numbers in Prof. Farber's data and analyses. This is because of a data

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[265] Plaintiffs' Class Cert Motion, pp. 11–12.

[266] See Section 3.2.3.

[267] See Workpaper 18.

[268] See Workpaper 19.

[269] Exhibit 26 shows promotion rates for the full sample of class members and male counterparts, without imposing the filters associated with the regression sample.

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processing error he makes when using GS's Peoplesoft database. The error causes him to assign the incorrect promotion year to 360 individuals.[270] For example, Prof. Farber reports that there were *no* promotions in 2006 and 2008, but that is not true. In my dataset I correct Prof. Farber's data processing errors, and my exhibit reports the correct numbers.

Exhibit 26
Promotion rate from VP to EMD by division and year
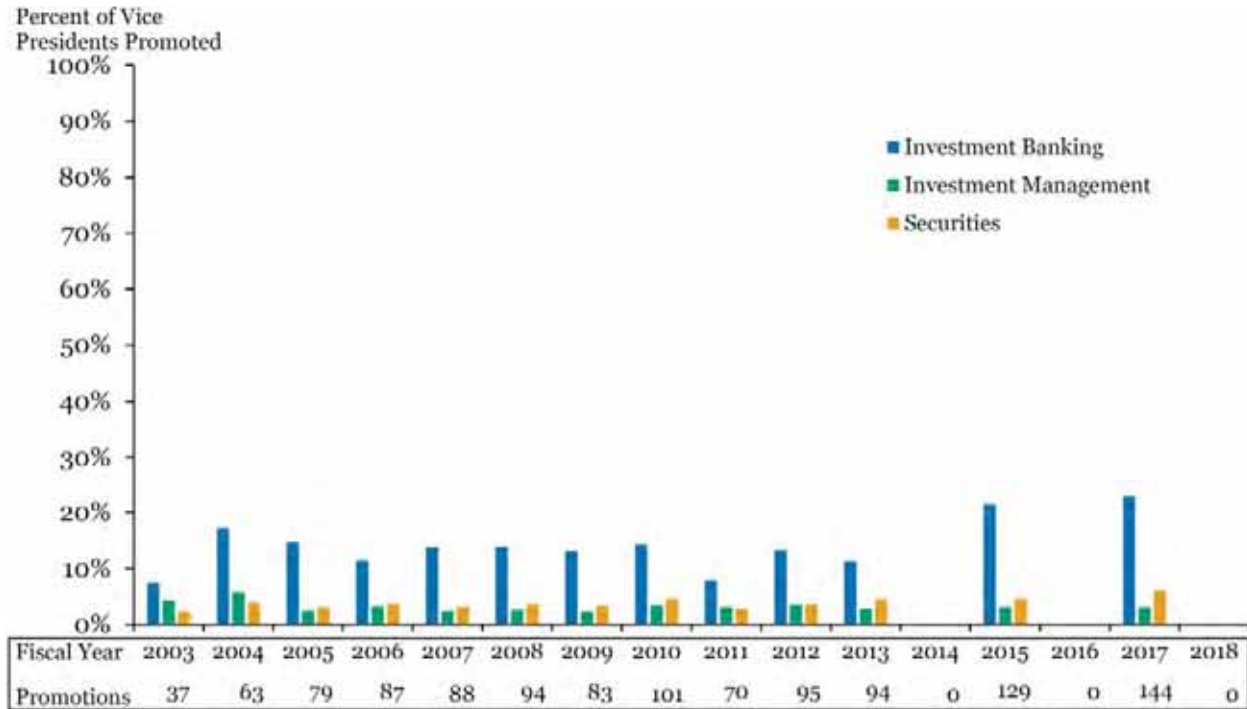
Percent of Vice Presidents Promoted

Legend:
- Investment Banking
- Investment Management
- Securities

Fiscal Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Promotions	37	63	79	87	88	94	83	101	70	95	94	0	129	0	144	0

Source: Goldman Sachs Data Production
Note: The sample consists of Vice Presidents in the relevant divisions as of the end of the fiscal year. Junior Bankers in Investment Banking are excluded from the sample. There were no promotions in fiscal years 2014, 2016, or 2018.

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226. Step 1: Nomination. The nomination process begins with input from managers and Business Unit leaders at the division level and involves several rounds of discussion. Following these discussions, the division heads approve and submit a final list of candidates for promotion to the firm-wide Talent Assessment Group.[271]

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[270] See Data Annex.

[271] Deposition of Bruce Larson, June 12, 2013, p. 232 ("Q. So am I understanding you correctly, that the division heads must approve the list and then IBD HCM submits it to the firm-wide talent assessment group? ... A. Following the inputs from the various people that I described through those processes, the division heads sign off on the list that gets turned in to the talent assessment group.").

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227. Step 2: Cross-ruffing. Concurrent with the nomination process, the divisional heads approve lists of "cross-ruffers." As I explained in Section 3.2.3, cross-ruffers are a group of managing directors (including EMDs and PMDs) that are "responsible for providing an independent viewpoint on the candidates" and ensuring that standards are applied in evaluating the candidates.[272] The number of cross-ruffers varies by division: eight to ten in IMD, ten to thirteen in Securities, and nine to twenty-one in IBD.[273]

228. As detailed in Section 3.2.3, the cross-ruffers thoroughly evaluate the nominees in their division, engaging in an extensive interview process with the nominees. Once cross-ruffers complete their interviews, they come up with their overall recommendations for promotion, and meet several times in order to create a ranked list of all nominees within a division.[274] This list is submitted to the firm-wide Talent Assessment Group; at this point, the division heads also have the opportunity to review the rankings of the cross-ruffing team and submit their own independent ranking to the Talent Assessment Group.[275] Next, Executive Office and other senior people at the firm meet with the division heads and cross-ruffing team captains to discuss the ranked nominees.[276] The final list for promotion is then presented to the Management Committee, and promotions are announced shortly thereafter.[277]

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[272] See footnote 164.

[273] See footnotes 166, 167, and 168.

[274] Deposition of Caroline Heller Sberloti Vol. I, July 10, 2013, pp. 224–226 ("Q. So following the interviews, what happens next? A. The cross-ruffing teams meet weekly as the interviews are conducted so you'll continue to have meetings as you're conducting interviews. Q. To discuss how the interviews are going or -- A. To discuss how the interviews are going and talk about the merits of the candidates. ... Q. Okay. And so then how long does the cross-ruffing process take? A. Year to year, it may vary slightly but I would say about five weeks of interviews and meetings of the team. Q. And then what happens? A. The cross-ruffing team produces a ranked list, 1 through N."); The four levels are "Outstanding Candidate," "Strong Candidate," "Borderline Candidate," and "No Promotion." See "2017 Managing Director Selection Cross-Ruffing Best Practices Guide," 2017, GS0375264 – 76 at GS0375273. Prior to 2009, candidates were assigned one of five levels: "One of the best in firm at 'senior' VP level," "Consistently exceeds the results expected," "Solid but not noticeably outstanding," "Acceptable and meets nominal standards," and "Currently below what is needed at MD level." See Deposition of Bruce Larson, June 12, 2013, Exhibit 159 [GS0004777 – 98 at GS0004796].

[275] Deposition of Bruce Larson, June 12, 2013, pp. 246–247 ("Q. Do the division heads have the ability to change the rank order of the candidates? A. The rank order was created by the cross-ruffing captains, gets submitted by the cross-ruffing captain. The division heads have an opportunity to submit their own independent ranking to the firm-wide talent assessment group as well.").

[276] Deposition of Bruce Larson, June 12, 2013, pp. 247–248 ("Q. What is the next step after those two lists are submitted? A. The cross-ruffing captain has the opportunity to meet with a subcommittee of the management committee of the firm who has been assigned the responsibility of promotions for that particular year and explain the rationale and reason behind their rankings. The division heads have the opportunity to do the same thing with regards to the rankings they have created. ... A. The final list that gets created reflects the input of all those meetings."); GS0375264 – 76 at GS0375270.

[277] Goldman Sachs, "Leadership," available at https://www.goldmansachs.com/who-we-are/leadership/management-committee/, accessed on June 12, 2019; GS0375264–276 at 270; Deposition of Bruce Larson, June 12, 2013, p. 248:16–20.

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5.3.2. *Farber's analysis of alleged gender differences in promotions is inconsistent with his prior analyses of alleged gender gaps*

229. In Prof. Farber's report, he analyzes promotions from Vice President to EMD for 2003–2018. When he analyzes the differences in promotion rate by gender, he runs a two-stage analysis. In the first stage, he runs a probit regression that predicts a binary outcome that takes a value of either 1 (promoted) or 0 (not promoted). He runs this regression only on the population of *male* Vice Presidents. After running this initial regression for males, he applies the results from the male-only regression to the population of female Vice Presidents in order to predict what their promotion rate *would have been* if they were males. Prof. Farber's purported finding from this analysis is that there are fewer women actually promoted to EMD than predicted using his male-only regression model.

230. Prof. Farber's approach to modeling gender differences in promotion differs from the approach he uses in all his previous analyses for the challenged processes and compensation. In all of his other variations, Prof. Farber includes both males and females and then uses a female indicator variable to isolate the associated effect of gender. Prof. Farber maintains this is the proper way to evaluate the gender gap in all prior analyses, but he does not explain why it would no longer apply to evaluating the gender gap in promotions.

231. In addition to providing no justification for his change in methodology, Prof. Farber's analysis continues to be susceptible to the same critiques that apply to his primary compensation model. For example, he does not include controls for production or performance, even though these variables are tied to promotion decisions at Goldman Sachs.

5.3.3. *Regression analysis finds no gender gap in the probability of promotion or being nominated for promotion*

232. As noted above, there are two key steps in the promotion process: (1) selection to the nominee list, and (2) cross-ruffing, which concludes with actual promotion from the nominee list. Plaintiffs allege disparities in the cross-ruffing stage of the process, yet Prof. Farber analyzes promotion decisions without conditioning on nomination which takes place prior to cross-ruffing (he also does not separately analyze the nomination process). I understand that nomination is not itself a challenged process in this matter, but as Prof. Farber

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does not separately discuss or analyze it when analyzing promotions as a whole, I study it below.

233. In order to analyze alleged gender disparities in promotions, I use probit regression models of nomination and promotion similar to my regression models of review scores and compensation. I include the controls used in my review score and compensation models, making small modifications to account for reduced sample size.[278]

234. **Step 1.** I begin by analyzing alleged gender differences in the probability of nomination for promotion. I run my regression model separately by division in order to reflect the fact that nomination takes place within each division. I report the results of this exercise in Exhibit 27.

- Row 1 displays a probit model for promotion that only includes a female indicator variable and no other control variables.

- Row 2 includes Prof. Farber's variables from his regression model of promotions.

- Row 3 adds job variables, including Business Unit and function.

- Row 4 adds production variables.

- Row 5 adds controls for manager quartile, 360 review scores, and OMR.

235. I find that after controlling for job variables, production, and performance, there are no significant, negative gender gap in nomination in any division (row 5). Indeed, when I include these controls, I find that women are actually nominated at a higher rate than men in two of the three divisions—significantly so in Securities. I report all results in Exhibit 27 as the percentage point difference between men and women's promotion rates. For example, women in securities are 3.41 percentage points more likely to be nominated than men after controlling for all relevant variables. Variables that capture production and performance are important to consider in a model of promotions, as they are the criteria used to evaluate professionals throughout their careers.

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[278] For the following controls, observations in the relevant sample that fulfilled the criteria outlined next were pooled. Education levels of "Bachelor's Degree," "Associates Degree," and "Some College". Business units and functions with fewer than 100 observations per division. Locations with fewer than 40 observations per division. AA Job groups with fewer than 250 observations for all three revenue generating divisions.

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Exhibit 27

Women are nominated for promotion to EMD at least as often as men across all divisions

Probit Marginal Effects	Investment Banking	Investment Management	Securities
1. No Controls	-9.33 *	-1.67	-0.18
2. Farber Controls	-8.60 *	-0.57	-0.41
3. Add Job Controls	-6.85 *	-0.14	0.24
4. Add Production Controls	-7.09 *	0.22	2.04 *
5. Add Review Controls	-1.76	0.63	3.41 *

Source: Goldman Sachs Data Production

Note: "*" after estimated marginal effect of being female on nomination rate indicates statistical significance of the marginal effect at the 5% level. Standard errors are clustered at the individual professional level. The table shows the average marginal effect of being female relative to males, for females, on the probability of receiving a nomination to EMD. Average marginal effects are reported in percentage points. All models are filtered to only observations that have non-missing values and estimable marginal effects for the full model. The sample consists of Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, non-missing manager quartile, non-missing 360 review score / OMR, and who were not self-sustaining Private Wealth Advisors. Junior Bankers and fiscal years with no promotions are excluded from the regression sample. There were no promotions for 2014, 2016, or 2018.

Row 1 displays a probit model for promotion that only includes a female indicator variable and no other controls.

Row 2 includes Farber controls: year, location, education, tenure, VP tenure, related prior experience, AA job group, and whether a professional was a lateral hire. Locations with fewer than 40 Vice Presidents are pooled in the regression. Job groups with fewer than 250 observations in the relevant sample are pooled in the regression. Education levels of "Bachelor's Degree," "Associates Degree," and "Some College" are pooled.

Row 3 adds Job controls. For all divisions, job controls include Business Unit, and a flag for professionals who transferred divisions within a fiscal year. Investment Management job controls also include function. For Securities, job controls also include function and an indicator for covered. Business Units and functions with fewer than 100 observations are pooled together in the regression. AA job group and related prior experience are removed.

Row 4 adds Production controls. Investment Banking production includes quartiles and lag quartiles of annualized production measured as 1. revenue from all projects and 2. revenue from projects for which the professional is the client representative. An indicator set to one if the professional holds a client representative role is also included. Investment Management production controls include Investment Composite Score, Investment Composite Score squared, and quartiles and lagged quartiles of gross sales of "Long Term Fee Based" products. Missing and negative Investment Composite Scores are set to zero and total assets under "Long Term Fee Based" products are available from 2011–2018. Securities production controls include the quartile and lagged quartile of production. Models that control for production also control for an indicator that is set to one when the relevant production variable is missing.

Row 5 adds Review controls. Review controls include: manager quartile, 360 review scores, and OMR. Manager quartile controls are fixed effects for each quartile and an indicator set to one when manager quartile is missing. For 360 review scores and OMR, controls include one variable with fixed effects for 360 review scores from 2005–2009; 360 review scores from 2010–2015; and OMR values from 2016–2018. The 360 review scores and OMR control is interacted with an indicator for each of the relevant review periods.

236. **Step 2.** Next, I analyze alleged gender differences in probability of promotion, that is being recommended for promotion after cross-ruffing conditional on nomination to be cross-ruffed. I use the same model as in my analysis of nomination. I report these results in Exhibit 28 as the percentage point difference between men and women's promotion rates. First, I find that even without controlling for nominee characteristics, women nominees are promoted no less often than men (row 1). Second, after controlling for function, Business Unit, and production, women nominees are more likely to be promoted than men (row 4). Controlling for performance metrics nearly doubles women's promotion advantage in Securities and Investment Banking

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(row 5). Conditional on being nominated for promotion, women VPs advance to EMD at a higher rate than men across all three divisions.

Exhibit 28

Conditional on being nominated for promotion, women are promoted to EMD at a higher rate than men

Probit Marginal Effects	Investment Banking	Investment Management	Securities
1. No Controls	8.48	-1.01	-4.59
2. Farber Controls	4.02	-3.48	-3.60
3. Add Job Controls	4.72	1.24	-3.08
4. Add Production Controls	2.00	2.01	2.87
5. Add Review Controls	7.89	1.67	6.00

Source: Goldman Sachs Data Production

Note: "*" after estimated marginal effect of being female on promotion rate indicates statistical significance of the marginal effect at the 5% level. Standard errors are clustered at the individual professional level. The table shows the average marginal effect of being female relative to males, for females, on the probability of receiving a promotion to EMD conditional on nomination. Average marginal effects are reported in percentage points. All models are filtered to only observations that have non-missing values and estimable marginal effects for the full model. The sample consists of nominated Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, non-missing manager quartile, non-missing 360 review score / OMR, and who were not self-sustaining Private Wealth Advisors. Junior Bankers and fiscal years with no promotions are excluded from the regression sample. There were no promotions for 2014, 2016, or 2018.

Row 1 displays a probit model for promotion that only includes a female indicator variable and no other controls.

Row 2 includes Farber controls: year, location, education, tenure, VP tenure, related prior experience, AA job group, and whether a professional was a lateral hire. Locations with fewer than 40 Vice Presidents are pooled in the regression. Job groups with fewer than 250 observations in the relevant sample are pooled in the regression. Education levels of "Bachelor's Degree," "Associates Degree," and "Some College" are pooled.

Row 3 adds Job controls. For all divisions, job controls include Business Unit, and a flag for professionals who transferred divisions within a fiscal year. Investment Management job controls also include function. For Securities, job controls also include function and an indicator for covered. Business Units and functions with fewer than 100 observations are pooled together in the regression. AA job group and related prior experience are removed.

Row 4 adds Production controls. Investment Banking production includes quartiles and lag quartiles of annualized production measured as 1. revenue from all projects and 2. revenue from projects for which the professional is the client representative. An indicator set to one if the professional holds a client representative role is also included. Investment Management production controls include Investment Composite Score, Investment Composite Score squared, and quartiles and lagged quartiles of gross sales of "Long Term Fee Based" products. Missing and negative Investment Composite Scores are set to zero and total assets under "Long Term Fee Based" products are available from 2011–2018. Securities production controls include the quartile and lagged quartile of production. Models that control for production also control for an indicator that is set to one when the relevant production variable is missing.

Row 5 adds Review controls. Review controls include: manager quartile, 360 review scores, and OMR. Manager quartile controls are fixed effects for each quartile and an indicator set to one when manager quartile is missing. For 360 review scores and OMR, controls include one variable with fixed effects for 360 review scores from 2005–2009; 360 review scores from 2010–2015; and OMR values from 2016–2018. The 360 review scores and OMR control is interacted with an indicator for each of the relevant review periods.

237. Taken together, the findings in these regressions show that looking across the entire pool of VPs within each division, women are not promoted at a lower rate than men. In Exhibit 29, I analyze the gender gap in the probability of promotion for the entire pool of VPs within each division, not just those nominated for promotion.[279] I report these results in Exhibit 29 as the

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[279] This analysis considers the probability of promotion to VP from all professionals in the division, not just those who are selected to the nominee list.

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percentage point difference between men and women's promotion rates. **I find that women VPs are no less likely to be promoted to EMD than their male counterparts are. In fact, I find that women are significantly more likely to be promoted in Securities than men**.[280]

Exhibit 29

Overall, women are promoted to EMD at least as often as men—if not more often than men—across all divisions

Probit Marginal Effects	Investment Banking	Investment Management	Securities
1. No Controls	-3.75	-1.04	-0.50
2. Farber Controls	-4.40 *	-0.52	-0.54
3. Add Job Controls	-3.25	-0.21	-0.05
4. Add Production Controls	-3.78	0.04	1.23 *
5. Add Review Controls	0.49	-0.02	2.69 *

Source: Goldman Sachs Data Production

Note: "*" after estimated marginal effect of being female on promotion rate indicates statistical significance of the marginal effect at the 5% level. Standard errors are clustered at the individual professional level. The table shows the average marginal effect of being female relative to males, for females, on the probability of receiving a promotion to EMD. Average marginal effects are reported in percentage points. All models are filtered to only observations that have non-missing values and estimable marginal effects for the full model. The sample consists of Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, non-missing manager quartile, non-missing 360 review score / OMR, and who were not self-sustaining Private Wealth Advisors. Junior Bankers and fiscal years with no promotions are excluded from the regression sample. There were no promotions for 2014, 2016, or 2018.

Row 1 displays a probit model for promotion that only includes a female indicator variable and no other controls.

Row 2 includes Farber controls: year, location, education, tenure, VP tenure, related prior experience, AA job group, and whether a professional was a lateral hire. Locations with fewer than 40 Vice Presidents are pooled in the regression. Job groups with fewer than 250 observations in the relevant sample are pooled in the regression. Education levels of "Bachelor's Degree," "Associates Degree," and "Some College" are pooled.

Row 3 adds Job controls. For all divisions, job controls include Business Unit, and a flag for professionals who transferred divisions within a fiscal year. Investment Management job controls also include function. For Securities, job controls also include function and an indicator for covered. Business Units and functions with fewer than 100 observations are pooled together in the regression. AA job group and related prior experience are removed.

Row 4 adds Production controls. Investment Banking production includes quartiles and lag quartiles of annualized production measured as 1. revenue from all projects and 2. revenue from projects for which the professional is the client representative. An indicator set to one if the professional holds a client representative role is also included. Investment Management production controls include Investment Composite Score, Investment Composite Score squared, and quartiles and lagged quartiles of gross sales of "Long Term Fee Based" products. Missing and negative Investment Composite Scores are set to zero and total assets under "Long Term Fee Based" products are available from 2011–2018. Securities production controls include the quartile and lagged quartile of production. Models that control for production also control for an indicator that is set to one when the relevant production variable is missing.

Row 5 adds Review controls. Review controls include: manager quartile, 360 review scores, and OMR. Manager quartile controls are fixed effects for each quartile and an indicator set to one when manager quartile is missing. For 360 review scores and OMR, controls include one variable with fixed effects for 360 review scores from 2005–2009; 360 review scores from 2010–2015; and OMR values from 2016–2018. The 360 review scores and OMR control is interacted with an indicator for each of the relevant review periods.

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[280] I also find that female self-sustaining Private Wealth Advisors are neither nominated for promotion nor promoted significantly less often than their male counterparts. **In fact, all of the female SSPWAs who were nominated for cross-ruffing were eventually promoted to EMD.** See Workpaper 20.

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5.4. Conclusion: There is no evidence of systemic gender bias in 360 review scores, manager quartiling, or promotions; therefore, there are no damages tied to the challenged processes

238. Taking analyses in this section together, it is clear that the 360 review, OMR, manager quartiling, and promotion processes are not systemically biased against class members.

- Looking across division and corporate title (and 360 framework), the gaps between women's and men's 360 review scores and OMRs are statistically insignificant in most cases. Indeed, even Prof. Farber finds no gender gap in the OMR.

- There is also large and statistically significant variation in gender gaps in 360 review scores across Business Units, with women in many Business Units receiving better scores, on average, than men in the same groups. Indeed, when I augment by Prof. Farber's regression model with relevant production variables, there is no adverse gender gap for 85 percent of the women, who work in Business Units having no statistically significant gender difference or a statistically significant gender difference favoring women.

- Furthermore, many women receive better 360 review scores than comparable men, as predicted by Prof. Farber's regression model augmented with production variables.

- Similarly, Prof. Farber finds no gender differences in manager quartiling 2016 to 2018, and prior to 2016, I find that 94 percent of Class Members were in a division-corporate job title where there was no significant, negative gender gaps in manager quartiling.[281]

- Finally, women are promoted to EMD no less often than men. If anything, they are promoted at higher rates than comparable men—and this favorable gap is statistically significant in Securities.

239. I find it notable that looking across the challenged processes, the evidence of alleged gender bias is weakest when analyzing promotion to EMD. Promotion to EMD is a significant business decision for GS. The fact that women fare as well as (or better than) men in the promotion process is strongly inconsistent with the claim GS's performance and review processes exhibit a common bias against women. It would not make business sense for GS to

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[281] See backup to Exhibit 24.

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design a 360 review and quartiling system that is systemically biased against women, and to then **favor women relative to men** at the critical step of promotion to EMD. Again, a more plausible interpretation of the data is that the inconsistent gender gaps across outcomes and subgroups do not reflect bias against either women or men, but rather, they reflect unmeasured factors not in the models.

240. Further, the absence of common bias in the challenged processes means that there cannot be common gender gaps in compensation or promotion *caused by* the challenged processes. Put differently: class members cannot be paid less or be less likely to be promoted *because* of bias in the challenged processes if the challenged processes do not, in fact, exhibit bias across class members. Since there is no common bias in the challenged processes, such bias could not have *caused* gender differences in compensation or promotion, and therefore could generate **no damages** associated with the challenged processes.

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6. MY ANALYSIS SHOWS THAT THE DATA REJECT PLAINTIFFS' CLAIM THAT COMPENSATION SETTING IS SYSTEMICALLY BIASED AGAINST WOMEN

241. In addition to claiming that female professionals are subjected to common bias in the 360 review, manager quartiling, and promotion processes, Plaintiffs also claim that female professionals are underpaid relative to similarly situated men. I understand from GS's counsel that compensation setting is not at issue in this matter, apart from any links between compensation and the challenged processes, nor are classwide damages at issue. As a result, Prof. Farber's analyses of gender gaps in compensation that are *not* caused by the challenged processes are entirely irrelevant to the claims in this case. In this section, I evaluate these analyses, and Plaintiffs' claims about compensation more generally, only because Prof. Farber includes them in his report. My analysis proceeds in several steps.

242. I begin with an overview of Prof. Farber's regression model of compensation in **Section 6.1**. In particular, based on my methodological review in Section 4, I explain how Prof. Farber's model has two main flaws: it is (a) missing important variables that are relied on by decision makers when setting pay (e.g., controls for job function, Business Unit, productivity, and performance), and (b) methodologically incapable of testing whether any gender gap in pay is common across the firm.

243. In **Section 6.2,** I present my regression model and its estimates of the gender gap for each division at issue. I show that the gender gap Prof. Farber finds is largely driven by his decision to exclude the aforementioned variables from his model. In particular, I show that when I include these variables in my model, the gender gap that Prof. Farber finds disappears in all three divisions for Associates and for VPs in Securities. Once I account for outliers by analyzing median gender gaps, I also find that there is no significant gender gap in *any* division for either Associates or VPs.

244. In **Section 6.2.4**, I address the second flaw in Prof. Farber's model: he assumes common bias across decision makers instead of analyzing the gender gap at the level of the decision maker. As detailed in Section 3.2.4, decisions about compensation are made by different decision makers across different Business Units. In Section 6.2.4, I use my regression model of compensation to test directly whether the alleged gender gap in pay is common across Business Units. I find that there is no common gender gap.

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6.1. Overview of Prof. Farber's regression model of compensation

245. When analyzing compensation, Prof. Farber controls for a limited set of variables: education, experience, division, year, office location, and an indicator for being a lateral hire. Prof. Farber excludes many variables that are important to compensation setting (as discussed in Section 3) including: (a) measures of "jobs" that are strongly correlated with compensation (e.g., Business Unit and job function), (b) measures of production that exist across the different divisions, and (c) measures of performance, like manager quartile and 360 review score. This choice causes his model to miss important differences across professionals and to improperly inflate the estimated gender gap in PATC.

246. Further, Prof. Farber estimates just one regression model for Associates and one model for VPs across the entire class. That is, he pools together professionals in all divisions, Business Units, and jobs into a single regression. Each of his regressions *assumes* that there is a single gender gap across the entire firm for the corporate title in question. As detailed in Section 3 (and analyzed later in this section), Prof. Farber's approach of using just one regression per corporate title is inconsistent with the decentralized decision-making used to set each professional's compensation.

247. Exhibit 30 compares Prof. Farber's model of compensation to my model. I rectify his flaws. The top of the exhibit points out that his model is misspecified as he does not separate professionals by division. The rest of Exhibit 30 compares my specification to his, displaying the variables that he omits. Prof. Farber's model is sparse and excludes variables that, according to the record, affect compensation decisions at GS. I rectify this in my own baseline, where I include (among other variables) Business Unit, function, production measures, 360 review scores, OMR, and manager quartile.

248. As noted above, Prof. Farber defends the exclusion of 360 review scores and manager quartiles from his baseline compensation model by alleging that those measures are, themselves, biased. However, as detailed in Section 5, I do not find evidence to support this claim of systemic bias, so I do not believe the exclusion of these important variables is methodologically defensible. These variables capture important information about individual-level performance that would otherwise be excluded from the model. In the next section, I show that using my corrected model for each division, there is no evidence of a common gender gap in compensation across class members.

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Exhibit 30
Variables and samples used in Farber and Shaw models

	Farber	**Shaw**
	(One model per title, two total.)	(One model per division-title, six total.)
Controls		
Year	✓	✓
Education	✓	✓
Office Location	✓	✓
Experience	• Time at GS (quadratic) • Relevant prior experience (quadratic)	• Time at GS (quadratic) • Time in position (quadratic) • Years in IBD (Jr. Banker only)
Job Type	• AA Job Group • Division • Business Unit (in "Model 3"; omitted from "Model 2")	• Business Unit, fully interacted with year • Function (IMD and Securities only) • Division transfer indicator
Lateral Hire	• Lateral hire indicator • Indicator for year of lateral hire	• Lateral hire indicator • Indicator for year of lateral hire
Production	-	• IBD: current and lagged quartile of annualized revenue on all projects. Current and lagged quartile of annualized revenue on "rep" projects and indicator for project rep for Sr. Banker only • IMD: Investment Composite Score (quadratic and VP only); current and lagged quartile of annualized gross sales on Long Term Fee Based products (VP only) • Securities: current and lagged annualized production quartile
Performance Assessment	-	• Indicator for top Manager Quartile • 360 review score • Indicator for Outstanding OMR
Other	-	• Indicator for covered professional (Securities only) • Indicator for guaranteed pay
Sample		
Time period	• IBD: 2003–2018 • IMD: 2003–2018 • Securities: 2003–2018	• IBD: 2005–2018 • IMD: 2005–2018 • Securities: 2005–2018
Exclusions	• Person-years w/ missing control variables, including AA Job Code/360/OMR/manager quartile/compensation • Part-time employees • Employees who are terminated/retired/deceased during the year	• Self-sustaining Private Wealth Advisors • Person-years w/ missing 360/OMR/manager quartile/compensation • Part-time employees • Employees who are terminated/retired/deceased during the year

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6.2. Regression analysis by division does not show evidence of a common gender gap

6.2.1. The alleged gender gap in compensation varies by division

249. I begin my analysis of compensation by examining how gender gaps in PATC differ *across divisions*. As detailed throughout this report, the three divisions at issue in this matter operate distinctly. Across the divisions, professionals with different skills perform different jobs, and different sets of decision makers set compensation. Thus, examining how the gender gap differs across divisions is necessary to evaluating Plaintiffs' claims of systemic bias. In addition, a Chow test rejects Prof. Farber's assumption that the divisions share a common model of compensation setting.[282]

250. In Exhibit 31 and Exhibit 32, I present the estimated gender gaps from my baseline models by division. The exhibits are organized so that my results can be directly compared to Prof. Farber's. Each of the exhibits has the same format—detailed below—which highlights how the exclusion of key variables from Prof. Farber's model drives the alleged gender gaps he measures.[283]

- The first bar on the left in each chart reports the raw gender gap in compensation and the R-squared (explanatory power) of a model that only controls for gender. This model reports raw differences between men and women and ignores any differences in other variables, such as experience or tenure, that could be correlated with both gender and compensation. Even Prof. Farber agrees that this difference is not meaningful in evaluating Plaintiffs' claims of discrimination.

- The second bar reports the gender gap and R-squared using the controls from Prof. Farber's "model 2a," which include tenure and education but exclude appropriate controls for job type, production, and reviews.

- The third bar corrects Prof. Farber's controls for tenure and job. Note that the gender gap shrinks, and the R-squared increases.

- The fourth bar adds controls for production variables, as defined in Exhibit 30. The gender gap shrinks further, and the R-squared increases.

- The final bar adds manager quartile, 360 review scores, and OMR. Again, the gender gap shrinks— and becomes *positive* (i.e., favorable to

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[282] See Workpaper 21.

[283] I present additional detail on my regression results in Exhibit 68 in the appendix.

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women) for Associates in Investment Banking and Investment Management.

251. Two key patterns emerge in the exhibits. First, when I use my full set of controls, I find no statistically significant gap in compensation for Associates in any of the three divisions and no statistically significant gap for VPs in Securities. These four groups account for 66 percent of the class member observations in the regression analysis.[284] Therefore, simply analyzing the gender gap at the division level, the evidence is inconsistent with the claim of systemic gender bias across the class.

252. Second, as I add additional control variables to the model that Prof. Farber omits, the gender gap continues to shrink in size. As these exhibits make clear, nearly all of the "gender gap" measured by Prof. Farber's model is driven by omitted variable bias, rather than by gender. VPs in the Securities division illustrate this problem quite clearly. Securities is a division within GS where quantitative measures of an individual employee's production are critical to compensation. As I show in Exhibit 32, the introduction of data on production reduces the gender gap by nearly half. Further, notice that (a) the R-squared for the model jumps from just 29 percent to 78 percent and (b) the gender gap becomes statistically insignificant when we move from Prof. Farber's limited model to my fullest model.[285] This pattern demonstrates that the gender gap Prof. Farber measures is *not* due to bias, but rather, it is due to variables excluded from his model. For VPs in Securities, those variables incrementally explain 49 percent of the variation in pay for VPs in securities (78 percent minus 29 percent), yet they are excluded from his model.

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[284] See Workpaper 22.

[285] Academic research indicates that this particular pattern in a regression model – a large increase in R-Squared accompanied by a large decrease in the coefficient of interest – is indicative of omitted variable bias. See, e.g., Emily Oster, "Unobservable Selection and Coefficient Stability," *Journal of Business & Economic Statistics*, DOI, 2017, pp. 1–18 at p. 2 ("The key observation is that the quality of the control is diagnosed by how much of the variance in the outcome is explained by its inclusion or, equivalently, how much the R-squared moves when the controls are introduced. Omitted variable bias is proportional to coefficient movements, but only if such movements are scaled by the change in R-squared when controls are included."); Daniel L. Rubinfeld, "Reference Guide on Multiple Regression," in *Reference Manual on Scientific Evidence*, Third Edition (Washington, DC: The National Academies Press, 2011), pp. 303–357 at p. 314 ("The importance of omitting a relevant variable depends on the strength of the relationship between the omitted variable and the dependent variable and the strength of the correlation between the omitted variable and the explanatory variables of interest. Other things being equal, the greater the correlation between the omitted variable and the variable of interest, the greater the bias caused by the omission.").

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Exhibit 31

Adding basic control variables for job, production, and performance to Prof. Farber's model erases the "gender gap" and improves the model's explanatory power

Investment Banking Junior Bankers

- Female-Male Compensation Gap (Not Significant)
- Female-Male Compensation Gap (Significant)
- Explanatory Power (R-Squared)

	No Controls	Farber Model 2a [1]	Correct Tenure and Job Controls [2]	Add Production Controls [3]	Add Controls for 360 Review Score, OMR, and Manager Quartile (Baseline) [4]
Explanatory Power (R-Squared)	0%	59%	74%	75%	83%
Female-Male Compensation Gap	-3.81%*	-3.25%*	-1.91%*	-1.89%*	0.19%

Investment Management Associates

- Explanatory Power (R-Squared)
- Female-Male Compensation Gap (Not Significant)

	No Controls	Farber Model 2a [1]	Correct Tenure and Job Controls [2]	Add Production Controls [3]	Add Controls for 360 Review Score, OMR, and Manager Quartile (Baseline) [4]
Explanatory Power (R-Squared)	0%	20%	59%	59%	67%
Female-Male Compensation Gap	-0.27%	-0.67%	1.21%	1.21%	1.57%

Securities Associates

- Female-Male Compensation Gap (Not Significant)
- Female-Male Compensation Gap (Significant)
- Explanatory Power (R-Squared)

	No Controls	Farber Model 2a [1]	Correct Tenure and Job Controls [2]	Add Production Controls [3]	Add Controls for 360 Review Score, OMR, and Manager Quartile (Baseline) [4]
Explanatory Power (R-Squared)	1%	30%	55%	68%	77%
Female-Male Compensation Gap	-11.72%*	-8.59%*	-7.73%*	-4.17%*	-1.32%

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Source: Goldman Sachs Data Production

Note: Exhibit shows estimates of gender differences in PATC using alternative models with the specified set of controls. "Female-Male Compensation Gap" refers to the percent difference between female and male compensation implied by the estimated coefficient on a female indicator variable (the "female coefficient") in each model specified. "*" after estimated pay gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level. The sample consists of Associates and Junior Bankers in the relevant divisions as of the end of the fiscal year who had non-missing PATC, had non-missing manager quartile, had non-missing 360 review score / OMR, and who were not self-sustaining Private Wealth Advisors. Investment Banking, Investment Management, and Securities have 4,626, 2,951, and 4,948 observations respectively.

[1] Farber controls include: year, location, education, tenure, related prior experience, AA job group, whether a professional was a lateral hire, and whether a professional was a new lateral hire. Tenure is time at GS, and time at GS squared.

[2] For all divisions, tenure is time in position, time in position squared, time at GS, and time at GS squared. For Junior Bankers in Investment Banking, tenure includes years in Investment Banking. AA job group and related experience have been removed. For all divisions, job controls include Business Unit, an interaction between Business Unit and year, an indicator for guaranteed pay, and whether a professional transferred divisions within a fiscal year. Investment Management job controls also include function. For Securities, job controls also include function and an indicator for covered.

[3] Investment Banking production controls include quartiles and lagged quartiles of (non-rep) production. From 2005–2011, production (non-rep) is the total revenue from all projects in a given year. There are no production controls for Investment Management Associates. Securities production controls include quartiles and lagged quartiles of production. Models that control for production also control for an indicator that is set to one when relevant production variable is missing. All production variables are annualized.

[4] Controls for 360 review score, whether a progessional received an Outstanding OMR, and whether a professional was placed in the top manager quartile. For all divisions, such controls include an interaction between 360 review scores and a review regime indicator for the periods 2005–2009, 2010–2015, and 2016–2018, an indicator for receiving an Outstanding OMR, and an indicator for being placed in the top manager quartile.

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Exhibit 32

Adding basic control variables for job, production, and performance to Prof. Farber's model erases the "gender gap" and improves the model's explanatory power

Investment Banking Senior Bankers

Investment Management Vice Presidents

Securities Vice Presidents

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Source: Goldman Sachs Data Production

Note: Exhibit shows estimates of gender differences in PATC using alternative models with the specified set of controls. "Female-Male Compensation Gap" refers to the percent difference between female and male compensation implied by the estimated coefficient on a female indicator variable (the "female coefficient") in each model specified. "*" after estimated pay gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level. The sample consists of Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, had non-missing manager quartile, had non-missing 360 review score / OMR, and who were not self-sustaining Private Wealth Advisors. Investment Banking, Investment Management, and Securities have 2,217, 7,264, and 11,476 observations respectively.

[1] Farber controls include: year, location, education, tenure, related prior experience, AA job group, whether a professional was a lateral hire, and whether a professional was a new lateral hire. Tenure is time at GS, and time at GS squared.

[2] For all divisions, tenure is time in position, time in position squared, time at GS, and time at GS squared. For Junior Bankers in Investment Banking, tenure includes years in Investment Banking. AA job group and related experience have been removed. For all divisions, job controls include Business Unit, an interaction between Business Unit and year, an indicator for guaranteed pay, and whether a professional transferred divisions within a fiscal year. Investment Management job controls also include function. For Securities, job controls also include function and an indicator for covered.

[3] Investment Banking production controls include quartiles and lagged quartiles of (non-rep) production. From 2005–2011, production (non-rep) is the total revenue from all projects in a given year. From 2012–2018, production (non-rep) is "Accrued [Revenue] Inc Mark." For Investment Banking Senior Bankers, production controls also include quartiles and lagged quartiles of (rep) production and an indicator for whether an employee is in a client representative role. From 2005–2011, production (rep) is the total revenue from projects on which the employee was the client representative. This measure is unavilable from 2012–2018. Investment Management production controls include Investment Composite Score, Investment Composite Score squared, and quartiles and lagged quartiles of gross sales of "Long Term Fee Based" products. Missing and negative Investment Composite Scores are set to zero and total assets under "Long Term Fee Based" products are available from 2011–2018. Securities production controls include quartiles and lagged quartiles of production. Models that control for production also control for an indicator that is set to one when relevant production variable is missing. All production variables except the Investment Composite Score are annualized.

[4] Controls for 360 review score, whether a progessional received an Outstanding OMR, and whether a professional was placed in the top manager quartile. For all divisions, such controls include an interaction between 360 review scores and a review regime indicator for the periods 2005–2009, 2010–2015, and 2016–2018, an indicator for receiving an Outstanding OMR, and an indicator for being placed in the top manager quartile.

6.2.2. *Accounting for the effects of outliers in regression analyses by division*

253. A common methodological concern in regression analysis is the influence of "outlier" observations on the estimated coefficients of interest. An outlier is a data point that has a value that diverges sharply from the vast majority of other data points. As a result, its inclusion in the model can lead to findings that are not reflective of broader patterns in the sample being analyzed.[286]

254. In labor economics, outliers can be a significant concern when trying to assess the effect of specific variables on compensation. If a small number of employees earn compensation that diverges greatly from that of the typical employee, it is likely that their compensation is either determined differently than most of the population, or is driven by an uncommon set of circumstances that cannot be captured by a regression model. As a result, the relationship between compensation and the factors that *can* be included in the regression model likely differs for this group of high earners. Including this group in the

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[286] Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, Fifth Edition, (Mason, OH: South-Western Cengage Learning, 2012), p. 327 ("OLS is susceptible to outlying observations because it minimizes the sum of squared residuals: large residuals (positive or negative) receive a lot of weight in the least squares minimization problem. If the estimates change by a practically large amount when we slightly modify our sample, we should be concerned.").

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same regression as the other employees skews the results, causing the regression model to either vastly overstate or understate the typical effect of certain variables on pay. For example, if one were to include Steve Jobs (an extremely high earner without a college degree) in a regression that attempts to measure the effect of education on compensation in the tech sector, his presence in the sample might greatly depress the estimated effect of a college degree on earnings. Mr. Jobs would dramatically skew the results because his compensation is so anomalous for people without college degrees.

255. As I discuss in this section, accounting for outliers is a significant concern when analyzing compensation at GS because the financial services labor market exhibits high monetary returns to extremely high performance and for those who work extremely long hours in some jobs. This can lead to a small number of professionals generating unique value in the marketplace and earning commensurately high compensation. In labor economics, we refer to this type of labor market—where a particular skill has extremely high market value—as a "star" labor market.[287]

256. Professional basketball is a classic example of a star labor market: the total market value of "superstar" players like LeBron James or Michael Jordan diverges sharply from that of the average player. Thus, any analysis of the variables that drive compensation for professional basketball players *as a whole* would need to analyze superstar compensation separately from that of average players. In the finance industry, similar dynamics are often at work. For example, consider a young star banker who is unusually successful at generating new business for someone of his or her tenure and, as a result, earns much higher compensation than his or her peers with the same observable characteristics. Including such a banker in the same regression model as his or

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[287] A large labor economics literature has explored the phenomenon of superstar labor markets, in which there are high returns to talent, allowing top performers to earn substantially more than their peers. See, e.g., Frederik Andersson, Matthew Freedman, John Haltiwanger, Julia Lane, and Kathryn Shaw, "Reaching for the Stars: Who Pays for Talent in Innovative Industries?", *The Economic Journal*, 119(June), 2009, pp. F308–F332; Sherwin Rosen, "The Economics of Superstars," *American Economic Review*, 71(5), 1981, pp. 845–858. A range of academic studies has documented this phenomenon in the finance industry. See, e.g., Steven N. Kaplan and Joshua Rauh, "Wall Street and Main Street: What Contributes to the Rise in the Highest Incomes?", *The Review of Financial Studies*, 23(3), 2010, pp. 1004–1050 at 1048 ("We think the most plausible explanation of our findings is the interaction of scale and technological change. That is precisely the argument made in Rosen (1981), who argues that technological change, particularly in information and communications, can increase the relative productivity of superstars or talented individuals.") and Claire Célérier and Boris Vallée, "Returns to Talent and the Finance Wage Premium," *The Review of Financial Studies*, 32(10), 2019, pp. 4005–4040 at 4020 ("…we find that returns to talent are significantly higher in finance than in the rest of the economy.").

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her peers would distort the estimated relationship between tenure and compensation.

257. Compensation data shows that GS operates in exactly such a star labor market. For example, in 2010, market data collected by Towers Watson indicates that about half of investment bankers at GS and its competitors earned less than $500,000, while approximately four percent earned more than $2,000,000.[288] In Exhibit 33, I show how this dynamic is at play among Senior Bankers at GS. Exhibit 33 displays the top five percent of earners in each year from 2005 through 2018. Again, a relatively small number of professionals earn very high compensation relative to their peers. While the median Senior Banker tends to earn between $500,000 and $1,000,000 depending on the year, there are a small number of professionals, disproportionately men, who earn well over twice the median earnings. This small group of individuals with extremely high pay has an outsized effect on the average gender difference in PATC.

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[288] Investment banking compensation followed a similar distribution at GS. See GS1043351 − 94 at GS1043366.

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Exhibit 33

The small number of extremely high-paid male professionals must be accounted for when modeling compensation

Investment Banking Senior Bankers, 2005–2018
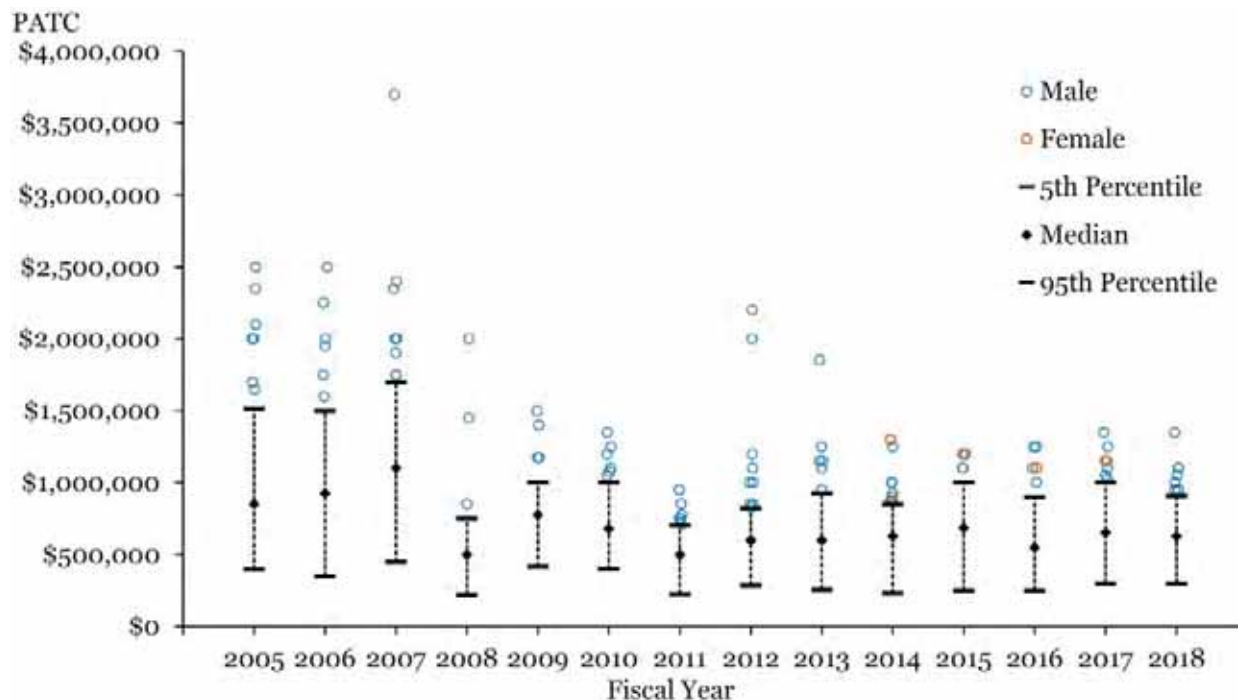
Source:Goldman Sachs Data Production

Note: The sample consists of Senior Bankers in Investment Banking as of the end of the fiscal year who had non-missing PATC, non-missing manager quartile, non-missing 360 review score / OMR, and who were not self-sustaining Private Wealth Advisors. Individual compensation is displayed for the top 5 percent of earners in each year, color coded by gender.

258. In Exhibit 34 I re-run my regressions by division and corporate job title while removing the extraordinarily high earners from the analysis. I then compare the results to those from my baseline compensation regression (which includes the high earners) to illustrate the effect of those high earners.

- For reference, Row 1 displays my "baseline" compensation regression with the full sample of professionals. This model is the corrected regression model I presented in the preceding subsection.

- Row 2 displays the results of a regression estimated using the same set of control variables as the baseline regression, after removing professionals

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with compensation greater than 1.5 times the interquartile range (the 75th percentile minus the 25th percentile) above the 75th percentile.[289]

- Row 3 displays the results of a regression estimated using the same set of control variables as the baseline regression, after removing professionals with compensation in the top five percent of all professionals in the specified group.[290]

- Row 4 displays the results of a regression estimated using the same set of control variables as my baseline regression, after removing professionals with compensation in the top ten percent of all professionals in the specified group.

259. The estimated gender gap becomes more favorable to women once I remove extraordinarily high earners. Of particular note is that female Associates in IMD are actually paid significantly *more* than men, and female Senior Bankers in IBD are not paid significantly differently than men, regardless of the specific group of high-earners I exclude. This reflects the fact that at least part of the gender gap is due to a small number of male professionals with extraordinarily high compensation.

Exhibit 34
There is no common gender gap after omitting individuals with extraordinarily high compensation

Regression Sample	Investment Banking		Investment Management		Securities	
	Junior Bankers	Senior Bankers	Associates	Vice Presidents	Associates	Vice Presidents
1. Baseline Regression – Full Sample	0.19%	-5.11% *	1.57%	-5.21% *	-1.32%	-2.74%
2. Remove Compensation Outliers	0.65%	-3.86%	2.43% *	-4.25% *	-0.02%	-2.56%
3. Compensation at or below 95th Percentile	0.69%	-3.77%	2.51% *	-4.28% *	-0.27%	-2.64%
4. Compensation at or below 90th Percentile	0.82%	-2.89%	2.57% *	-4.38% *	-0.06%	-2.53%

Source: Goldman Sachs Data Production
Note: Table shows the percent difference between male and female compensation implied by the estimated coefficient on a female indicator variable (the "female coefficient") in the specified model. "*" after estimated pay gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level.
Row 1 displays the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, and whether a professional was placed in the top manager quartile. Analysis uses Baseline Regression Sample.

[289] This approach for identifying outliers was developed in John W. Tukey, *Exploratory Data Analysis*, (Pearson, 1977). In theory one could also use this same approach to remove exceptionally low earners from the regression; but the distribution of earnings in the sample is such that there are no outliers on the low end, just the high end.

[290] Using percentile cutoffs to identify unusually large (or small) values is common in labor economics; see, e.g., Joshua D. Angrist and Alan B. Krueger, "Empirical Strategies in Labor Economics," in *Handbook of Labor Economics,* Volume 3, ed. Orley Ashenfelter and David Card (Elsevier Science B.V., 1999), pp. 1348–1349.

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Row 2 removes Compensation Outliers from the regression in Row 1. Compensation Outliers are defined as observations with
compensations that are more than 1.5 times the interquartile range above the 75th percentile for compensation. No observations are
more than 1.5 times the interquartile range below the 25th percentile for compensation. There are 235 observations in Investment
Banking, 593 observations in Investment Management, and 1,405 observations in Securities that are more than 1.5 times the
interquartile range above the 75th percentile for compensation.
Row 3 removes observations with compensation above the 95th percentile for compensation from the regression in Row 1.
Row 4 removes observations with compensation above the 90th percentile for compensation from the regression in Row 1.

260. Another widely-accepted method for addressing the influence of outliers
in a regression model is to analyze gender gaps in median compensation rather
than average compensation. Relative to averages, medians are much less
affected by small numbers of observations with very large values (in this case,
small numbers of professionals with very high compensation). As one widely-
used econometrics textbook notes:

> "Generally the median is less sensitive than the average to changes in
> the extreme values (large or small) in a list of numbers. This is why
> 'median incomes' or 'median housing values' are often reported, rather
> than averages, when summarizing income or housing values in a city or
> county."[291]

261. This characteristic of medians often implies that the difference in medians
between two groups is more representative of the *typical* difference between
members of the two groups. [292] For this reason, medians have also been
recognized as a helpful tool for limiting the influence of outliers in a litigation
context. As explained in the "Reference Guide on Statistics" from the Federal
Judicial Center*'s Reference Manual on Scientific Evidence:*

> "The mean can be found by adding all the numbers and dividing the
> total by how many numbers were added. By comparison, the median
> cuts the numbers into halves: half the numbers are larger than the
> median and half are smaller…The mean takes account of all the data—
> it involves the total of all the numbers; however, particularly with small
> datasets, a few unusually large or small observations may have too
> much influence on the mean. The median is resistant to such outliers.
> Thus, studies of damage awards in tort cases find that the mean is
> larger than the median. This is because the mean takes into account
> (indeed, is heavily influenced by) the magnitudes of the relatively few

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[291] Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, Fifth Edition, (Mason, OH: South-
Western Cengage Learning, 2012), p. 705.

[292] See D. Kaye and D. Freedman, "Reference Guide on Statistics," *Reference Manual on Scientific Evidence*,
Federal Judicial Center, 2011, p. 238.

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very large awards, whereas the median merely counts their number. If one is seeking a single, representative number for the awards, the median may be more useful than the mean."[293]

262. Due to a relatively small number of men with extremely high pay, for example, the gender difference in average PATC among Investment Banking Senior Bankers is 40 percent larger than the gender difference in median PATC.[294] In fact, the difference in medians is smaller than the difference in averages in four of the six division-corporate job title groups: Investment Banking Senior Bankers, Securities Associates, and Securities VPs.[295] This pattern suggests that a small number of highly paid men may be skewing the estimates of the average gap in at least some of the groups. To test whether this is the case, I use a statistical tool known as "median regression."

263. The regressions presented earlier, as well as those reported by Prof. Farber, study the *average* gap in pay using an OLS regression. To assess differences in medians, while still accounting for the variables in my baseline compensation model, I use a median regression.[296] In this context, a median regression yields estimates of the gender gap in *median* PATC (i.e., women's median PATC vs. men's median PATC) gap instead of the gender gap in *average (mean)* PATC.

264. Exhibit 35 shows the results. The median gender gap is not significant in *any* division-corporate job title groups. That implies that where they exist, average gender gaps in compensation are driven by a small number of outliers.

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[293] D. Kaye and D. Freedman, "Reference Guide on Statistics," *Reference Manual on Scientific Evidence*, Federal Judicial Center, 2011, p. 238.

[294] See Workpaper 23.

[295] See Workpaper 24.

[296] Median regression, also referred to as "least absolute deviations," is a commonly used statistical tool for analyzing data that contains "outliers" (such as a small number of professionals with very high compensation). Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, Fifth Edition, (Mason, OH: South-Western Cengage Learning, 2012), pp. 331–332 ("Rather than trying to determine which observations, if any, have undue influence on OLS estimates, a different approach to guarding against outliers is to use an estimation method that is less sensitive to outliers than OLS. One such method, which has become popular among applied econometricians, is called least absolute deviations (LAD)...In fact, it is known that LAD is designed to estimate the parameters of the conditional median...Because the median is not affected by large changes in the extreme observations, it follows that the LAD parameter estimates are more resilient to outlying observations.").

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Exhibit 35

There are no significant gender gaps in compensation using a median regression, which accounts for compensation outliers

Baseline Regression	Investment Banking		Investment Management		Securities	
	Junior Bankers	Senior Bankers	Associates	Vice Presidents	Associates	Vice Presidents
1. OLS Regression	0.19%	-5.11% *	1.57%	-5.21% *	-1.32%	-2.74%
2. Median Regression	0.53%	-2.13%	0.81%	-3.47%	-1.25%	-1.55%

Source: Goldman Sachs Data Production; Parente and Silva (2016)

Note: Both the OLS and Median regressions use the Baseline Regression Sample and incorporate the model for the Baseline compensation regressions, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, and whether a professional was placed in the top manager quartile. "*" after estimated pay gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level. Clustered standard errors for the median regression are calculated according to Parente and Silva (2016).

6.2.3. *Estimated gender gaps differ across divisions for lateral hires vs. "insiders"*

265. Another relatively small group of professionals whose compensation outcomes exhibit divergent patterns from the broader sample of professionals is lateral hires, i.e., VPs who were hired into the VP position from outside GS and Associates who were not hired directly from campus or promoted to Associate from within GS.[297] Approximately 20 percent of Associate and Junior Banker class members and 24 percent of VP and Senior Banker class members are lateral hires.[298] I refer to non-lateral hires as "insiders," since they rose through the ranks within GS or were hired directly from campus.

266. For the majority of insiders (81 percent), I find that there is no significant gap in compensation when I run my baseline model separately for insiders and lateral hires (Exhibit 36, rows 2 and 3). In particular, there is no significant gender gap in compensation for insider Associates in any of the three divisions, or for insider VPs in Securities and Senior Bankers in IBD.

267. Among lateral hires, the gender gap in compensation shrinks when I control for their' pay prior to joining GS (row 4). Laterals have important

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[297] In the data, I classify professionals as lateral or non-lateral hires within each stint for each title they hold at GS. For example, if a professional is hired laterally as an Associate and subsequently promoted to VP, I would consider her to be a lateral hire during her time as an Associate and a non-lateral hire during her time as a VP. For more details, see Appendix C – Variables and samples used in Shaw regression models.

[298] Workpaper 25.

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experience outside of GS that affects their compensation in the labor market.[299]
I control for prior pay to try to account for this important fact. Prior pay was
not set by GS, but may be a valuable proxy for the skills and strengths that a
professional brings to GS that are otherwise hard to measure in GS's data. Note
that prior pay is only available for 56 percent of yearly observations for lateral
hires, so the model incorporating prior pay only adds limited information
relative to the baseline model. Nevertheless, the estimated pay gaps shrink
when I add this limited information to the model, and are insignificant in IBD
and IMD and for Associates in Securities.

Exhibit 36
There are no significant gender gaps for insiders, and the gender gap varies for laterals

Baseline model	Investment Banking		Investment Management		Securities	
	Junior Bankers	Senior Bankers	Associates	Vice Presidents	Associates	Vice Presidents
1. All professionals	0.19%	-5.11% *	1.57%	-5.21% *	-1.32%	-2.74%
2. Insiders only	-0.07%	-3.28%	1.60%	-5.26% *	-0.74%	-0.74%
3. Laterals only	-0.61%	-7.35%	3.06%	-7.72% *	-2.30%	-10.24% *
4. Laterals only; add prior pay control	-0.69%	-5.75%	3.64%	-5.17%	-2.33%	-8.11% *

Source: Goldman Sachs Data Production

Note: Insiders are defined as non-lateral hires. "*" after estimated pay gaps indicates statistical significance of the female coefficient at the 5% level. The baseline model includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, and whether a professional was placed in the top manager quartile. Standard errors are clustered at the individual professional level. The sample consists of Associates and Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, non-missing manager quartile, non-missing 360 review score / OMR, and who were not self-sustaining Private Wealth Advisors. All professionals excludes observations with missing lateral flag. For All professionals, Investment Banking, Investment Management, and Securities respectively have 4,626, 2,951, and 4,948 observations for Associates / Junior Bankers, and 2,217, 7,264, and 11,476 observations for Vice Presidents / Senior Bankers. For Insiders, Investment Banking, Investment Management, and Securities respectively have 4,127, 2,260, and 3,940 observations for Associates / Junior Bankers, and 1,468, 4,709, and 8,497 observations for Vice Presidents / Senior Bankers. For Laterals, Investment Banking, Investment Management, and Securities respectively have 499, 691, and 1,008 observations for Associates / Junior Bankers, and 749, 2,555, and 2,979 observations for Vice Presidents / Senior Bankers. Prior pay is defined as the mean of a professional's annual compensation in the three years prior to joining Goldman Sachs. Prior pay data is available for 1,131 out of 2,198 laterals (51.5%) for Associates / Junior Bankers and for 3,615 out of 6,283 laterals (57.5%) for Vice Presidents / Senior Bankers.

6.2.4. _Regression analysis by Business Units also show that there is no common gender gap_

268. In addition to analyzing whether the gender gaps differ across divisions, it
is also important to assess gender gaps within finer subgroups that correspond
more precisely to the level at which compensation decisions are actually made.

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[299] For example, it has been well-established in the literature on executive compensation that lateral hires make
more than executives who are promoted internally. See Kevin J. Murphy and Ján Zábojník, "CEO Pay and
Appointments: A Market-Based Explanation for Recent Trends," _American Economic Review_, 94(2), 2004, pp.
192–196 at pp. 192–193.

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As detailed in Section 3, compensation for each professional at GS is set by decision makers within his or her Business Unit.

269. Given these facts, if Prof. Farber is correct that there is a *common* gender gap that affects all women Associates and VPs in the same way regardless of which Business Unit they belong to, then when I use my regression model to estimate distinct gender gaps for each Business Unit (by interacting an indicator for being female with Business Unit) I should see that gender gaps are similar across Business Units. Such a result could indicate that, for example, a common process causes all managers to underpay women by a common amount relative to men.

270. Instead, as detailed in this section, when I perform a direct statistical test (F-test) of whether gender gaps are the same across Business Units, my results indicate that the gender gaps differ significantly across Business Units. Importantly, in many Business Units, there is no statistically significant gender gap disfavoring women. In addition, some Business Units exhibit statistically significant gaps that favor *women*.

271. To test Plaintiffs' claim of systemic bias directly, I estimate one regression model for VPs/Senior Bankers and one for Associates/Junior Bankers, pooling the three divisions and interacting the gender variable with Business Unit. This allows me to estimate the gender gap for each Business Unit. As described in Section 3.1.3, the sets of Business Units changed over time as GS introduced new units and eliminated others. Across the full period, for Associates, the sample I analyze contains 78 unique Business Units in Securities, 30 in IMD, and 33 in IBD; and for Vice Presidents, the sample contains 81 unique Business Units in Securities, 40 in IMD, and 26 in IBD.[300]

272. In Exhibit 37, I report the gender gap specific to each Business Unit for VPs and Senior Bankers.[301] Bars above zero represent Business Units in which female professionals receive higher compensation than the men in the same Business Unit. Bars below zero represent Business Units in which female professionals receive lower compensation than men in the same Business Unit. Dark bars indicate that the gender gap is significantly different from zero.

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[300] Workpaper 26.

[301] For illustrative purposes, the exhibit displays results for Vice Presidents and Senior Bankers only; similar results for Associates are included in the exhibit backup.

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273. Contrary to Plaintiffs' claim of common bias, gender gaps differ widely among Business Units. Many Business Units have small gaps that are not statistically significant. In nine Business Units, women earn over 20 percent more than men do, after adjusting for the variables in my regression model.[302] Overall, 94 percent of female VPs and Senior Bankers, and 96 percent of female Associates and Junior Bankers, are in Business Units with no statistically significant, negative gender gap in pay.[303]

Exhibit 37
There is no common gender gap in compensation

Vice Presidents and Senior Bankers by Business Unit, 2005–2018
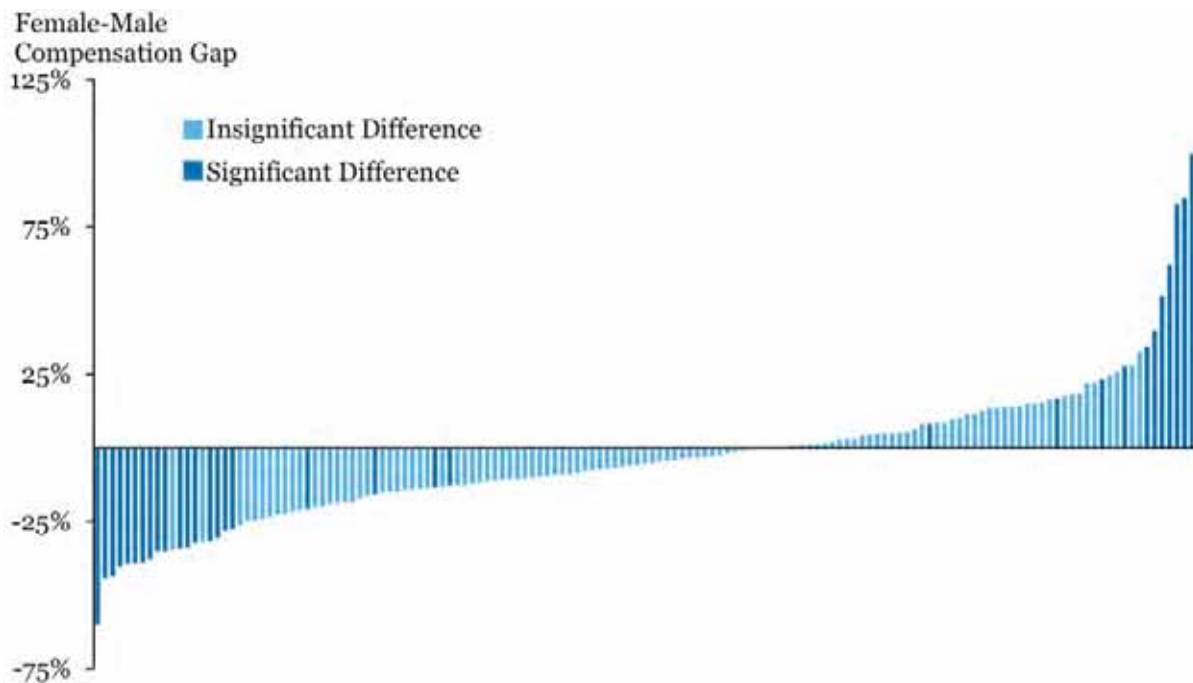
Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male Compensation Gap are displayed. The Female-Male Compensation Gap is estimated by a regression model of compensation. The regression specification incorporates the model for the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, whether a professional was placed in the top manager quartile, and division. The regression specification also includes an interaction between the female indicator variable and an indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male Compensation Gap refers to the percent difference between male and female compensation implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. Standard errors are clustered at the individual professional level. Statistical significance is determined at the 5% level. Analysis uses Baseline Regression Sample.

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[302] This only includes Business Units for VPs with a statistically significant gap of over 20 percent. See Appendix G for details.

[303] See backup to Exhibit 37.

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274. Exhibit 38 summarizes the results displayed in Exhibit 37, as well as the results for Associates. In this exhibit I report the fraction of women in each corporate job title and division who work in Business Units that exhibit significantly negative gender gaps, significantly positive gender gaps (that favor women), or no significant gap. The exhibit reports the results of an F-test for each corporate job title that tests whether the gender gap is the same across Business Units within that corporate job title.

275. There are two key patterns to note. First, the F-test for each corporate job title indicates that Prof. Farber's assumption that the gender gap is the same across Business Units within each corporate job title is false. Second, while the gender gaps at the Business Unit level are significantly different from each other, only a modest fraction of women are in Business Units where men are paid significantly more than women. The majority of women are in Business Units that exhibit no significant gender gap.[304]

276. There are also Business Units in which women are paid significantly more than men. Out of 162 Business Units, female VPs and Senior Bankers are paid significantly more in 11, and female Associates and Junior Bankers are paid significantly more in 19. Female VPs and Senior Bankers are paid significantly less in only 21, and female Associates and Junior Bankers are paid significantly less in only 19.[305]

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[304] For additional detail, in Appendix G I include a series of tables that lists each Business Unit, along with the size and significance of the estimated gender gap for that unit.

[305] These calculations are limited to the Business Units with both male and female professionals and an estimable gender gap for at least one corporate title. See backup to Exhibit 38.

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Exhibit 38

Gender gaps vary significantly across individual Business Units
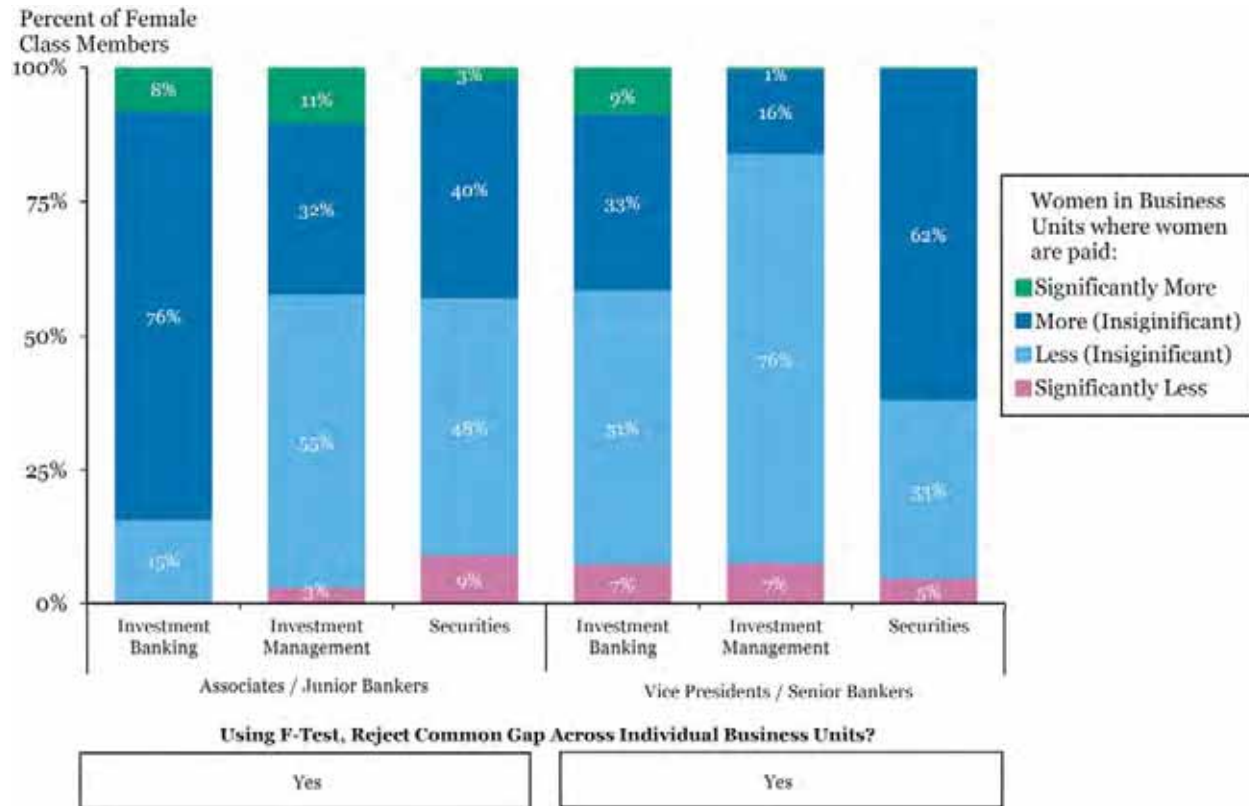
Source: Goldman Sachs Data Production

Note: Only female class members in Business Units with both male and female professionals and an estimable Female-Male Compensation Gap are displayed. The regression specification incorporates the model for the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, whether a professional was placed in the top manager quartile, and division. The regression specification also includes an interaction between the female indicator variable and an indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Individuals with missing Business Unit are included in the regression, but not shown in the chart. Female-Male Compensation Gap refers to the percent difference between male and female compensation implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. Standard errors are clustered at the individual professional level. Statistical significance is determined at the 5% level. Whether or not there is a common gap is tested with an F-Test. If there is less than one chance in twenty that the differences between the Female-Male Compensation Gaps across Business Units could be explained by random noise, the hypothesis is rejected. Analysis uses Baseline Regression Sample.

6.3. Even the fullest regression models cannot establish a causal link between gender and compensation

277. A primary challenge in trying to measure the causal effect of (a) any alleged bias in the challenged processes on (b) each individual class member's compensation is controlling for the many different variables considered in setting an individual's compensation at GS. The regression models above capture many of the variables that are important to determining professionals'

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compensation. However, given the individualized nature of compensation decisions across employees, the models *cannot* capture other important variables that matter for compensation, but that are difficult to measure. Thus, it is possible that the "gender gap" estimated by the model actually reflects differences in the other, omitted variables rather than the true effect of gender.[306]

278. As detailed in the preceding sub-sections, these concerns are not just theoretical. When I add to the regression model all the available information that Prof. Farber excluded regarding individual jobs, performance, and production, the gender gap decreases substantially. Indeed, for Associates in all divisions, VPs in Securities, and self-sustaining PWAs, the inclusion of these measures entirely explains the average gender gap in pay. Such patterns suggest that, if there are additional measures of individual production or performance that are missing from the model (because, for example, they are hard to measure or are not systematically recorded) then even in my fullest model, the estimated "gender gap" will not necessarily reflect gender, and will therefore not capture the *causal* effect of gender on PATC.[307] In the remainder of this section, I present a variety of analyses providing evidence of this defect in Prof. Farber's empirical approach.

6.3.1. *The combined testimony from GS and patterns in the data show that unmeasured variables have a larger effect on compensation than gender*

279. As discussed in Section 3, testimony in this matter suggests that the available data contain only rough measures of an individual's job responsibilities, such as Business Unit and function. The record also shows that the limited measures of job performance in the data do not capture the wide

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[306] See, e.g., David Neumark, "Experimental Research on Labor Market Discrimination," *Journal of Economic Literature*, 56(3), 2018, pp. 799–866 at p. 808 ("Although regression adjustments can, in principle, account for these differences, unexplained wage gaps can always be attributed to unmeasured productivity-related characteristics for which the regression fails to account, rather than discrimination."); Francine D. Blau and Lawrence M. Kahn, "Gender Differences in Pay," *Journal of Economic Perspectives*, 14(4), 2000, pp. 75–99 at p. 81 ("The typical approach to analyzing the sources of the gender pay gap is to estimate wage regressions specifying the relationship between wages and productivity-related characteristics for men and women. … But any approach which relies on a statistical residual will be open to question as to whether all the necessary independent variables were included in the regression. For example, even if measured human capital characteristics can explain only a portion of the wage gap between men and women, it is possible that unmeasured group differences in qualifications may explain part of the residual.").

[307] In more technical terms, the coefficient on any variable of interest in a regression model (i.e., gender in this case) captures the true effect of that variable only if the factors missing from the model are "orthogonal" (i.e., uncorrelated with) the variable of interest. The results discussed above in Section 6.1 demonstrate that condition is *not* true for Prof. Farber's regression model.

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range of individualized factors that managers evaluate when setting compensation.

280. Testimony from managers across the three divisions includes examples of such unmeasured factors. For instance:

> **Securities.** The head of the Principal Strategic Investment Business Unit in 2014 testified that, "Unlike sales or trading, the performance of PSI professionals are not primarily judged by the profit or loss associated with the investments that they make. They are primarily judged by their contributions to the Division's strategic priorities. The most successful individuals in PSI need to be good stewards of Firm capital, and must also positively contribute to the success of our franchise and enhance our ability to service our clients."[308]

> **IBD.** The managing director who oversaw the Financial Institutions Group Business Unit in IBD from 2003 to 2012 noted that "…the weight I have attributed to manager quartile placement in determining compensation often has varied from individual to individual. For example, I would generally put less emphasis on the quartile placement of a senior professional whose commercial productivity was especially strong."[309]

> **IMD.** In the former U.S. Third Party Business Unit as of 2014, "Individuals in Product Strategy/Product Development receive a salary and bonus, and in making compensation determinations we consider how proactive those professionals are (e.g., how many products they have developed, how well they present the products, and how many subadvisors they reach out to), and whether they leverage the Firm appropriately. In addition, because the members of this group must frequently present products at meetings and 'perform their technical expertise,' in determining their compensation we also consider their ability to drive agendas, their knowledge, and how commercially-minded they are."[310]

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[308] Declaration of Darren Cohen, July 1, 2014, p. 4.
[309] Declaration of Celeste Guth, June 30, 2014, p. 4.
[310] Declaration of James McNamara, June 30, 2014, p. 8.

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281. In addition, each division's compensation guidelines list a number of unmeasured factors that managers consider when setting compensation. These factors include ███████████████ and ███████████[311] In Securities, they also include "█████████████████████[312] and in IBD, they include ██

████████████████████[313] None of these factors are reflected in GS's data.

282. The compensation guidelines also highlight the limitations of the performance measures that *are* included in the data. For example, as discussed in Section 3, the data for Securities include a measure of the revenue generated by individual traders (also referred to as "RNOVs"). The compensation guidelines ████████████████████████████████

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283. Similar guidelines apply to the evaluation of production metrics in IMD and IBD.[315] More broadly, the guidelines in each division state that "...███

██

██████████████████████████"[316] The nature of each professional's activities, and the unique circumstances surrounding each professional's production, are not captured by GS's data. As a result, I cannot account for them in any statistical model of compensation.

284. Given these facts, a key question is how important these unmeasured production variables are in determining a professional's PATC. The standard

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[311] See, e.g., GS0113896 – 910 at GS0113902; GS0113426 – 39 at GS0113431; GS0113911 – 29 at GS0113916.

[312] See, e.g., GS0113896 – 910 at GS0113902.

[313] See, e.g., GS0113426 – 39 at GS0113431.

[314] See, e.g., GS0113896 – 910 at GS0113899.

[315] See, e.g., GS0113911 – 29 at GS0113913 – 4; and GS0113426 – 39 at GS0113428 – 9.

[316] See, e.g., GS0113896 – 910 at GS0113897; GS0113426 – 39 at GS0113426; GS0113911 – 29 at GS0113911.

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way to quantify the importance of such difficult-to-measure variables is using something called a "residual." An employee's "residual" is the difference between her actual PATC and her PATC as predicted by the regression model. The residual directly quantifies the portion of an individual's PATC that is explained by individualized variables that are missing from the model (or arbitrary noise).[317] To get a sense of how important these variables are in determining compensation, Exhibit 39 shows the average absolute size of professionals' "residuals" from my model as a percent of total compensation, as compared to the estimated gender gap for female professionals for each of the six main regressions (three regressions for Associates/Junior Bankers and three regressions for VPs/Senior Bankers, using my model that includes job variables, production variables, and 360 review scores, OMR, and manager quartiles).

285. The average absolute size of the residuals is clearly larger than the estimated gender gap. In other words, variables currently *omitted* from my model explain notably more about a woman's compensation than gender. This raises the possibility that omitted variables, not any bias in the decision-making process, cause any remaining gender gap.[318]

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[317] Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, Fifth Edition, (Mason, OH: South-Western Cengage Learning, 2012), pp. 211–212 ("Sometimes, it is useful to examine individual observations to see whether the actual value of the dependent variable is above or below the predicted value; that is, to examine the residuals for the individual observations. This process is called residual analysis. Economists have been known to examine the residuals from a regression in order to aid in the purchase of a home. ... The house with the most negative residual is, at least based on the factors we have controlled for, the most underpriced one relative to its *observed* characteristics. Of course, a selling price substantially below its predicted price could indicate some undesirable feature of the house that we have failed to account for, and which is therefore contained in the unobserved error. ... There are many other uses of residual analysis. One way to rank law schools is to regress median starting salary on a variety of student characteristics (such as median LSAT scores of entering class, median college GPA of entering class, and so on) and to obtain a predicted value and residual for each law school. The law school with the largest residual has the highest predicted value added.").

[318] The R-squared in my compensation models is relatively high, but a large R-squared alone cannot tell you (a) what is missing from the model, (b) how important that missing information is relative to the importance of gender, or (c) how that missing information might impact the estimated gender gap. See James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Third Edition Update, (Pearson, 2015), pp. 237–238 ("The [R-squared] and [adjusted R-squared] do NOT tell you whether...there is omitted variable bias, or [whether] you have chosen the most appropriate set of regressors.").

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Exhibit 39

The alleged gender pay gap in compensation is smaller than the unexplained portion of class members' pay
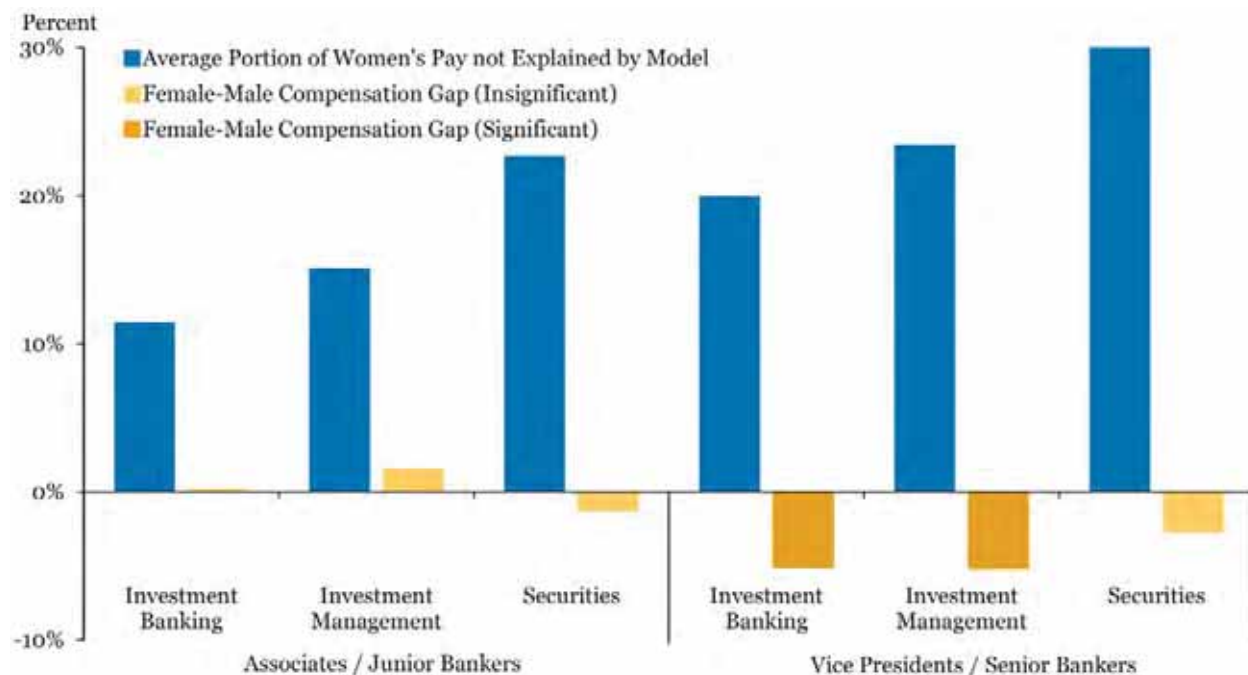
Sopurce: Goldman Sachs Data Production

Note: The regression specification incorporates the model for the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, and whether a professional was placed in the top manager quartile. Average Portion of Women's Pay not Explained by Model is calculated as the average of the absolute value of the percent residual from the regression model for all female class members in a given division. Analysis uses Baseline Regression Sample. Female-Male Compensation Gap refers to the percent difference between male and female compensation implied by the estimated coefficient on the female indicator variable in the specified model. Statistical significance is determined at the 5% level. Standard errors are clustered at the individual professional level.

6.3.2. *Unmeasured variables drive high compensation for many individual class members*

286. The problem of trying to isolate any potential effect of gender separately from unmeasured variables is particularly challenging at the level of the individual professional. As explained above, the "residual" for any given employee is the difference between his or her *actual* compensation and the compensation the model predicts he or she should receive based on variables in the model (e.g., Business Unit, job function, production, experience, education). The fact that the residuals are so large relative to the effect of gender means that even if women *on average* make less than comparable men in a regression model, many *individual* women will actually make *more* than comparable men. Indeed, in Exhibit 20 (Section 4.2.3), I illustrated this point for Plaintiff Allison Gamba, who earned much higher PATC than my regression model predicts she would have made if she were a man.

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287. As should be clear from Ms. Gamba's example, it is very difficult to assess whether the average gender gap measured by regression models like mine and Prof. Farber's imply that any *individual* class member was paid less *because* of her gender. Professionals like Ms. Gamba have very high compensation even relative to comparable males. Understanding the variables that drive her high compensation requires a specific inquiry into Ms. Gamba's performance, the decision makers who evaluated her, and the decision makers who set her pay.

288. In Exhibit 40 and Exhibit 41, I show that Ms. Gamba's example represents a pattern in the data in which many women are paid more than what would be predicted if they were men. In these two exhibits, I use my own regression model and Prof. Farber's regression model, respectively, to compare each class member's actual earnings to the earnings of a hypothetical comparable male.[319] The y-axis reports each woman's actual compensation. The x-axis reports what the regression predicts each woman would earn if she were male, based on her individual traits. If each woman were paid the same as a comparable man (based on the regression), all the dots would lie exactly along the 45-degree line. If each class member were paid less than a comparable man, all the dots would lie below the 45-degree line. In fact, while some women fall below the line, many lie above. Using my regression model, 37 percent of VPs and 46 percent of Associates make more than predicted for comparable males. Using Prof. Farber's model, 21 percent of VPs and 29 percent of associates make more than predicted for comparable males.[320] This means that many women make more than the regression predicts they would have made if they were male—even using Prof. Farber's own model. The fact that a regression model finds an average difference between men and women's pay does *not* mean that all women were underpaid relative to comparable men.

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[319] The results are similar if I analyze the logarithm of compensation and compare each class member's actual log compensation to the log compensation of a hypothetical comparable male. See backup to Exhibit 40 and Exhibit 41 .

[320] See Workpaper 27.

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Exhibit 40

Many women earn compensation that varies widely from, and is higher than, the predicted compensation of comparable men using my model

Securities Vice Presidents, 2015
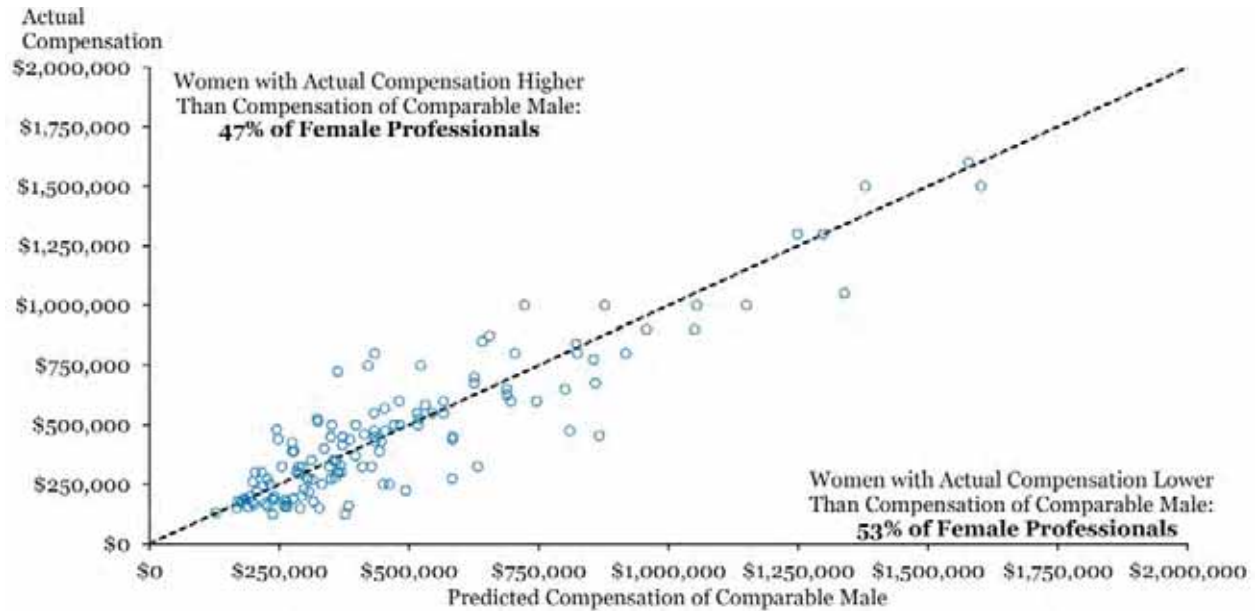
Source: Goldman Sachs Data Production

Note: Compensation of Comparable Male is estimated with a regression specification that incorporates the model for the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, and whether a professional was placed in the top manager quartile. Analysis uses Baseline Regression Sample. For each female professional, the coefficient on the female indicator variable is first subtracted from her predicted log compensation. This adjusted log compensation is then exponentiated and multiplied by the average exponentiated residual. The dashed line marks when Actual Compensation and Compensation of Comparable Male are equivalent.

Observations above $2,000,000 in either measure are not displayed for clarity.

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Exhibit 41

Many women earn compensation that varies widely from, and is higher than, the predicted compensation of comparable men using Prof. Farber's model

Securities Vice Presidents, 2015
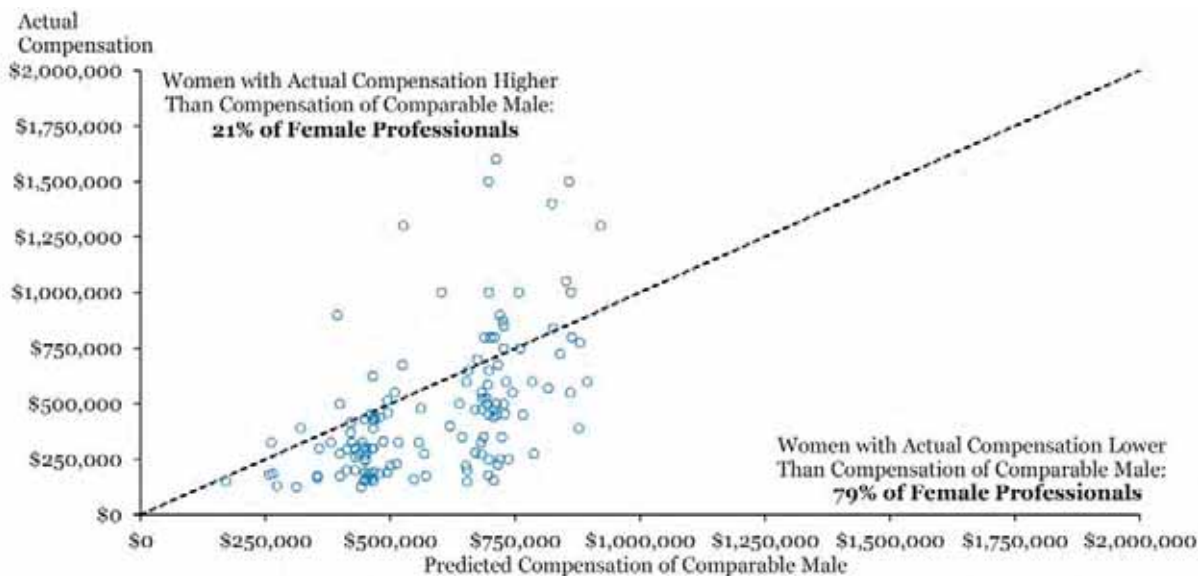
Source: Goldman Sachs Data Production

Note: Prof. Farber's regression model (Model 2a) includes controls for year, location, education, tenure, related prior experience, AA job group, whether a professional was a lateral hire, whether a professional was a new lateral hire, and division. Analysis uses Baseline Regression Sample. Predicted Compensation of Comparable Male is calculated by first estimating the log compensation of all professionals. For each female professional, the coefficient on the female indicator variable is first subtracted from her predicted log compensation. This adjusted log compensation is then exponentiated and multiplied by the average exponentiated residual. The model is pooled across all divisions, but separated by corporate job title. The dashed line marks when Actual Compensation and Predicted Compensation of Comparable Male are equivalent.

289. As is clear from Exhibit 40 and Exhibit 41, many women earn more than comparable males. Furthermore, in many instances the difference between a woman's actual pay and her predicted pay if she were a man is very large—even though these individuals are "perfectly matched" along all the variables in the model. In order to understand the variables that drive these large differences, one would have to investigate each woman's individual traits and performance, as well as the decision makers who set her pay: a single regression model analyzing average differences between men and women would not suffice.

6.3.3. *The alleged "bias" measured by regression models is not consistent across different decisions made by the same decision makers*

290. Another way to test whether the gender gaps measured by the regression are caused by alleged "bias"—rather than unmeasured characteristics of individual professionals—is to examine patterns of alleged bias across different outcomes for the *same* set of decision makers. Plaintiffs' theory of harm is that

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a lack of supervision and guidance in the review processes led to decision makers' biases affecting compensation decisions for class members.[321] If this theory is correct, any given Business Unit should exhibit negative gender gaps in the compensation regression model for both Associates and VPs. If a set of decision makers is biased, then there should be a consistently negative gender gap for women subject to its decisions. In this section, I examine this question by taking the results of my regressions in Section 6 and comparing gender gaps for VPs and Associates within each particular Business Unit.

291. I start my analysis with a hypothetical example in the top panel of Exhibit 42. In this scatter plot, each dot represents a different, hypothetical Business Unit. Dots above the horizontal line represent Business Units with a gender pay gap that favors female Vice Presidents. Dots below the line depict Business Units with a gender pay gap that disfavors women VPs. Dots to the right of the vertical line represent Business Units with a gender pay gap that favors female Associates, and dots to the left depict Business Units with a gap that disfavors women Associates.

292. If the gender gaps measured by the regression models capture the "biases" of the decision makers associated with each Business Unit, one would expect to see a consistent pattern of bias against both women Associates *and* women VPs when looking at the unit. The top panel of Exhibit 42 depicts this type of pattern—i.e., for all Business Units, the gender gap would be negative for both Associates and VPs.

293. This pattern is clearly not present in GS's actual data (bottom panel). In 76 percent of Business Units, at least one subgroup of women receives higher compensation than men. In addition, in Business Units where women Associates earn less than men, women Vice Presidents do not systematically earn less than men.[322] These patterns indicate that either (a) decision makers associated with each Business Unit have a complex form of bias where they favor women in some instances but not others—or (b) the gender differences estimated by the regression model are capturing the effects of important unmeasured variables that are unrelated to bias, and that vary randomly across groups of professionals.

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[321] Plaintiffs' Class Cert Motion, pp. 5–9. See also Cascio Report, ¶¶ 12–13.

[322] The other divisions look similar. A manager must manage both male and female Junior Bankers as well as both male and female Senior Bankers to obtain adjusted gender gaps from the regression.

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Exhibit 42

Hypothetical Example: common bias against women in each individual Business unit
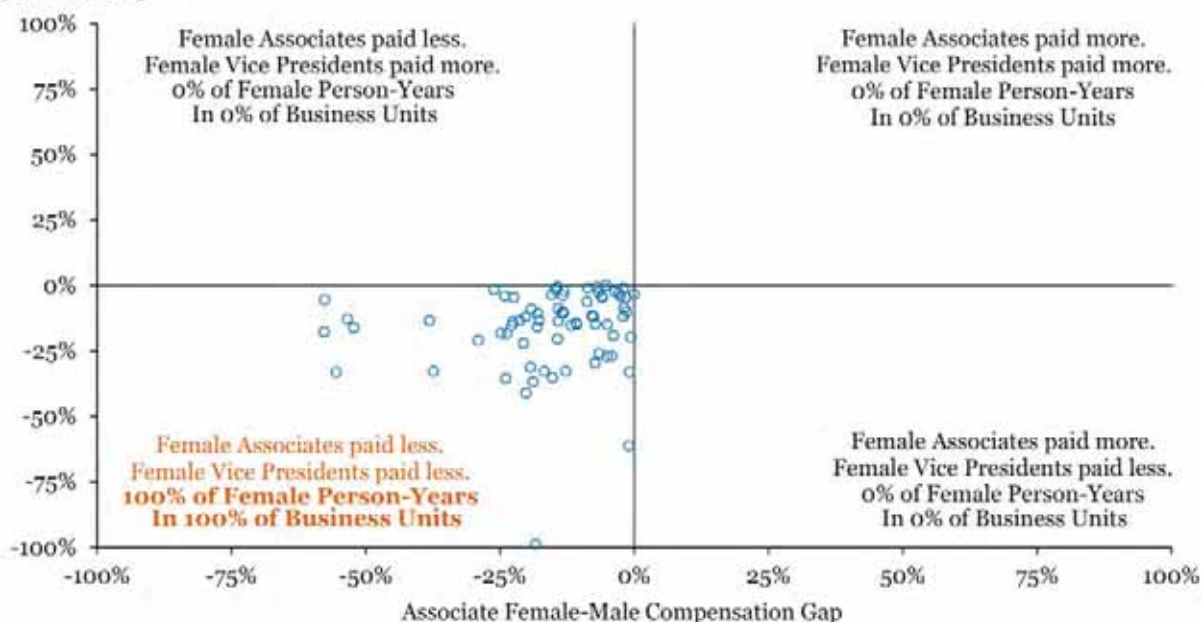
Actual gender gaps in compensation for each individual Business Unit are not consistent across Associates and Vice Presidents: Securities, 2005–2018
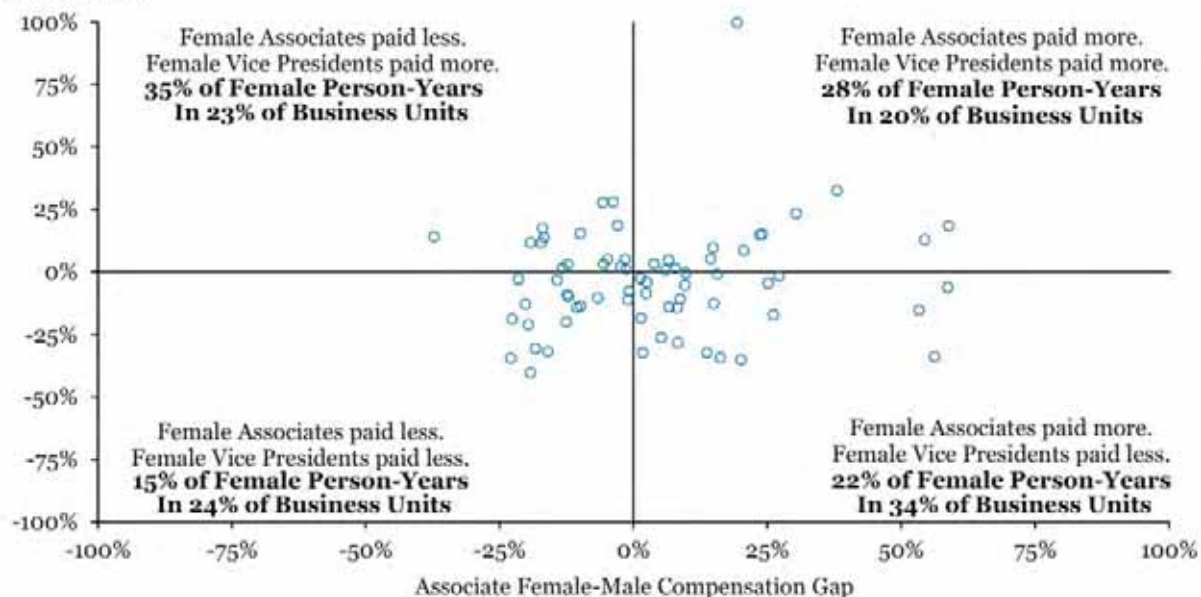
Source: Goldman Sachs Data Production

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Note: Each dot represents a Business Unit with both female and male professionals and estimable Compensation Gaps for Associates and Vice Presidents. The regression specification incorporates the model for the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, whether a professional was placed in the top manager quartile, and division. The regression specification also includes an interaction between the female indicator variable and an indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Individuals with missing Business Unit are included in the regression, but not displayed. Analysis uses Baseline Regression Sample. Female-Male Compensation Gap refers to the percent difference between male and female compensation implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. Female-Male Compensation Gaps above 100% are omitted for clarity.

6.4. Conclusion: there is no evidence of a common gender gap in compensation at GS

294. In this section I show that Prof. Farber's model is flawed in two ways. First, it is flawed because Prof. Farber assumes that there is one common gender gap across all subgroups—e.g., across divisions and Business Units. In doing so, Prof. Farber is disregarding the evidence that job duties differ and that compensation decisions are made in a decentralized manner. Second, it is flawed because by excluding variables that are known to be relevant in the compensation setting process (variables such as job roles and personal performance measures), Prof. Farber's model of the compensation regression is incorrectly specified, and thus his estimated gender pay gap is unreliable. After I correct these two flaws, I find no evidence of a common gender gap in compensation across class members.

295. Furthermore, even the fullest regression models Prof. Farber and I present cannot establish a causal link between gender and compensation. First, I showed that the very small, negative gender gaps in compensation estimated by my model for VPs in IBD and IMD may be capturing unmeasured variables that, if they could be measured, would eliminate the statistical significance of these gaps. The residuals in the compensation regressions—which are the differences between actual pay and what the regression predicts for pay—are enormous relative to the estimated gender gap in pay. In Exhibit 31 and Exhibit 32, I showed that as I add more variables to the compensation regression, the estimated gender coefficient shrinks. This suggests that if we knew more about pay determination, the estimated gap would disappear.

296. I also find that many women earn more than comparable males who are identical on characteristics controlled for in my regression model (or Prof. Farber's). This sharply undermines the allegation that there is systemic bias in compensation setting that disadvantages the class in a common way.

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7. THERE ARE NO DAMAGES ASSOCIATED WITH THE CHALLENGED REVIEW PROCESSES, BUT IF THERE COULD BE, PROF. FARBER'S CALCULATIONS ARE DEEPLY FLAWED

297. I understand that classwide damages are not at issue in this case, and that instead damages will be assessed individually, and only if there is a second phase of trial—making Prof. Farber's opinions regarding classwide damages inadmissible at trial. Nevertheless, given that Prof. Farber has presented opinions on this topic, I describe the obvious flaws in his analysis. Should the court revisit its decision that classwide damages are not admissible, I reserve the right to perform additional analyses.

298. Prof. Farber's most critical error is to find classwide damages where there is no evidence of systemic bias in the manager quartiling, 360 review, or promotion processes, as my results in Section 5 demonstrate. I found no common negative, significant gaps for any of the challenged processes. In the 360 review process, there are no such gaps in eight of the twelve subgroups I analyzed (and even Prof. Farber found no negative, significant gaps during the OMR period). In the remaining subgroups, gender differences in 360 scores varied significantly across groups of decision makers associated with different Business Units, a pattern that indicates any gaps found measure unobserved variables rather than systemic bias in GS's processes. I also found no common patterns in the manager quartiling process. Finally, I found no gender gaps in promotion adverse to women in any division, and in Securities, I found a significant gap in *favor* of women. **Since there is no systemic bias in the challenged processes, such bias could not have caused any gender differences in compensation or promotions, and therefore could generate no damages.**[323]

299. In this section, I discuss this and several other general flaws with Prof. Farber's approach to analyzing damages that further render each of his estimates unreliable. Though there are no damages—because I show no common bias against women in the challenged processes—I still point out reasons why Prof. Farber's damages estimates are flawed and inflated.

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[323] Indeed, Prof. Farber himself finds no gender gaps for the OMR and manager quartiling 2016 to 2018, and that women are promoted to EMD more than men in some years, implying no harm to those groups from those respective processes. See Farber Report, ¶ 114 and Table 29. In addition, many class members receive the best manager quartile (Q1), implying they could not have been injured by the manager quartiling process. See Appendix K.

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7.1. Prof. Farber's estimates of back-pay damages associated with 360 reviews and manager quartiling are inflated and unreliable

300. Prof. Farber claims that bias in the 360 review and manager quartiling processes reduced class members' compensation by $188M over the class period.[324] I discuss three broad ways in which Prof. Farber's estimate is flawed:

301. **Flaw 1:** As I have shown in Sections 4, 5, and 6, Prof. Farber's models for the challenged processes and compensation setting, which he uses to calculate damages, are fundamentally flawed and unreliable. As a result, his damages estimates are incorrect and inflated: damages are actually zero.

302. **Flaw 2:** Prof. Farber's calculation of damages after 2015 is unreliable and inconsistent with his own findings of no bias in OMR and manager quartiling after 2015.

- Prof. Farber assigns damages to VPs who did not receive reviews as VPs prior to 2016. While he finds no gender gaps in the challenged processes after 2015, Prof. Farber claims that VP class members were still injured after 2015 due to the long-term effect of bias from their VP reviews in earlier years.[325] By this logic, any class member who did *not* go through these processes as a VP before 2016 *cannot* have been injured. Nevertheless, Prof. Farber inappropriately includes such class members in his damages calculation from 2016 onwards.

- Prof. Farber also errs by including damages for VPs after 2015, despite finding no evidence of contemporaneous bias in the challenged processes. As I show below in Section 7.2, Prof. Farber's claim that purported bias before 2016 continued to affect compensation in later years is unsupported.

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[324] In this section, I describe Prof. Farber's estimated damages that he claims to be attributable to bias in the challenged processes (i.e., 360 reviews and manager quartiling). Prof. Farber also provides damages estimates based on his estimated overall gender gap in compensation. Since Prof. Farber himself finds that a large share of this gap is unrelated to the challenged processes, it would be inappropriate to use this estimate of the overall gender gap as a basis for any alleged damages. For this reason, I focus my discussion in this section on Prof. Farber's estimate of damages that are purportedly related to the challenged processes.

[325] See Farber Report, ¶¶ 120–123 and Table 23. Prof. Farber calculates the share of Associates and Vice Presidents in 2016–2018 with 0 or more years of pre-2016 performance reviews received in their respective positions. He finds that Vice Presidents are more likely than Associates to have received performance reviews in their position from 2003–2015, and thus concludes that Vice Presidents are more likely to have been adversely affected by these earlier allegedly biased reviews.

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303. Flaw 3: Prof. Farber's estimates fail to exclude all professionals who signed arbitration agreements.

- Prof. Farber purports to calculate variations of his damages estimates that exclude two groups of professionals: those who opted out of the class or signed Managing Director or severance agreements before the case was filed ("Exclusion Group 1") and those who signed Managing Director or severance agreements after the case was filed ("Exclusion Group 2"). Due to a simple data processing error, Prof. Farber misses information on 278 professionals who signed severance agreements after the complaint was filed and who therefore should have been part of his "Exclusion Group 2," which is intended to include all professionals who signed severance agreements.[326] Prof. Farber's damages estimates for putative class members without arbitration agreements (as he defines them) are therefore overstated.

- Prof. Farber also fails to calculate a variation of his damages estimates that excludes professionals who signed arbitration agreements included in their equity awards.[327] Prof. Farber's adjusted damages calculations described in the previous bullet remove professionals with other types of arbitration agreements, but these adjusted calculations assume that all professionals with equity award agreements are part of the class.[328] I understand that there is a ruling that these professionals are not part of the class if they do not affirmatively opt in, so Prof. Farber's damages calculation should have considered the effect of excluding these professionals.

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[326] Farber Report, ¶ 148 ("Thus the bottom panel of Table 26 is similar to the middle panel, but also excludes class members who: 1) signed a severance agreement, 2) signed a Managing Director agreement with an arbitration agreement therein, or 3) signed a Private Wealth Management agreement with an arbitration agreement therein. It does not exclude class members who accepted Equity Awards... I refer to this group as 'Exclusion Group 2.'").

[327] Farber Report, ¶ 148 ("Thus, the bottom panel of Table 26 is similar to the middle panel, but also excludes class members who: 1) signed a severance agreement; 2) signed a Managing Director agreement with an arbitration agreement therein; or 3) signed a Private Wealth Management agreement with an arbitration agreement therein. It does not exclude class members who accepted Equity Awards.").

[328] Prof. Farber provides two adjusted damages estimates that exclude certain professionals with arbitration agreements. The first adjusted estimate excludes professionals who opted out of the class or signed a Managing Director or severance agreement before the original complaint was filed. The second adjusted estimate is meant to further exclude professionals who signed Managing Director or severance agreements after the original complaint was filed, as well as professionals who signed Private Wealth Management agreements. Farber Report, ¶ 148 (" The middle panel of Table 26 excludes those former Class members who either: 1) opted out of the class in a timely manner; 2) signed severance agreements before the original complaint was filed; or 3) signed Managing Director agreements with arbitration agreements therein before the original complaint was filed. ... [T]he bottom panel of Table 26 is similar to the middle panel, but also excludes class members who: 1) signed a severance agreement; 2) signed a Managing Director agreement with an arbitration agreement therein; or 3) signed a Private Wealth Management agreement with an arbitration agreement therein. It does not exclude class members who accepted Equity Awards.").

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7.2. Contrary to Prof. Farber's claim, there is no evidence that the challenged processes were linked to any compensation differences after 2015, so his damages estimates are inflated

304. Prof. Farber finds no bias in the OMR or Quartile processes from 2016 onwards. However, he claims that the purported bias in these processes before 2016 continued to affect VP compensation in later years. This claim is entirely unsupported.

305. As an initial matter, my corrected models in Section 5 show that there is no evidence of common bias in the 360 review or manager quartiling processes. Therefore, such bias could not have caused any differences in compensation for class members in any time period.

306. In addition, Prof. Farber's conclusion is not supported even by his own models. Prof. Farber's argument is as follows. First, he finds no gender gap in compensation for Associates following the introduction of the OMR in 2016, but he finds that the gender gap increases slightly for VPs. Second, he claims that this pattern *could* be explained, "in part," by the fact that VPs are exposed to purported bias in the challenged processes for a longer period than Associates.[329] If current PATC is based on PATC in earlier years, which Prof. Farber alleges, then the effect of such purported bias in earlier years may persist over time. Without further investigation or empirical analysis, Prof. Farber concludes that the purported bias in the pre-OMR period had *exactly the same* effect on VP compensation in each of the subsequent five years, and assigns damages in those years accordingly.

307. This damages "analysis" is entirely unscientific and unreliable. The pattern of changes in the compensation gaps after 2015 could be explained by any number of other variables, and Prof. Farber does not address, much less rule out, any of these alternative explanations. As Prof. Farber himself acknowledges, only a portion of his estimated gender gaps in compensation are related to the challenged processes. The remainder of the gaps are explained by factors that are *unrelated* to the challenged processes and are omitted from his

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[329] Farber Report, ¶ 121 ("An important difference between Associates and Vice Presidents that could account in part for the contrast found in Table 22 with regard to the change over time to the female-male pay gap, is their relative tenure with Goldman. As I describe in the next paragraph, Associates in the 2016-2018 period are unlikely to have had much exposure to pre-2016 performance evaluations so that their current compensation is less likely to be adversely affected by these earlier evaluations. In contrast, Vice Presidents in the 2016-2018 period have been with Goldman long enough to have substantial exposure to pre-2016 performance evaluations and are more likely to adversely affected by these earlier evaluations.").

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regression model. This means that any patterns in the overall compensation gap over time could be due to changes in these omitted factors, such as production, job, or other unmeasured factors, rather than changes in the effects of gender differences in the challenged processes. In fact, when I add production and job controls to Prof. Farber's own model, I find that the pattern flips: the gender gap for VPs is shrinking after 2015, rather than increasing.[330]

308. A more logical, direct test of Prof. Farber's hypothesis is to measure the relationship between compensation and pre-2016 review scores/manager quartiles using his regression model of compensation. I do this simply by adding pre-2016 360 review scores and manager quartiles to Prof. Farber's own regression model of compensation from 2016–2018.[331] I do not endorse his flawed model, but this exercise assesses whether, in his own estimation, prior reviews and manager quartiles have a persistent effect on compensation after 2015.

309. Exhibit 43 shows that this simple test roundly rejects Prof. Farber's hypothesis.[332] If Prof. Farber's conclusion were correct (i.e., if the effects of the challenged processes were perfectly persistent), then all of the predicted effects in rows 1–6 for each process would be *positive and statistically significant*. In other words, if Prof. Farber were correct, then 360 review scores received before 2016 would continue to have the same effect on compensation no matter how much time has passed. Contrary to this prediction, there are *no* positive, statistically significant effects of manager quartiling over time, and significantly ***negative*** effects for 360 review scores after two years. This is the exact opposite of what one would expect if Prof. Farber's assumptions are correct about the persistent effect of the challenged processes on compensation after 2016.

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[330] See Workpaper 28.

[331] I follow Prof. Farber and analyze pre-2016 360 review scores and manager quartiles that a given professional received as a VP. See Farber Report, ¶¶ 120–123 and Table 23, in which Prof. Farber calculates the share of Associates and Vice Presidents in 2016–2018 with 0 or more years of pre-2016 performance reviews received in their respective positions. Since not all VPs received 360 review scores or manager quartiles in their position in any given year before 2016, I also control for whether each professional had non-missing review and quartile data in the given year.

[332] Each row in the table shows the estimated effect of the challenged processes from the pre-2016 period on compensation in the 2016–2018 period after the indicated number of years have elapsed. For example, the first row shows that a 0.1 increase in 360 review scores in 2015 is associated with an increase in compensation of 0.022 log points (roughly 2.2 percent) in 2016. The second row shows that such an increase in 2015 review scores is also associated with a 0.014 log-point (roughly 1.4 percent) increase in compensation in 2017. In contrast, the third row shows that a .1 increase in 2015 review scores is associated with a significant -0.012 log-point (roughly 1.2 percent) ***decrease*** in compensation in 2017; and the fourth row shows that review scores in 2015 also have a *negative and significant* effect on compensation in 2018.

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Exhibit 43

Using Prof. Farber's model, there is no long-term effect of pre-2016 360 review scores or manager quartiles on compensation from 2016–2018

Vice Presidents, 2016–2018

	Pre-2016 360 Review Score	Pre-2016 Quartile Placement	
		Top Quartile	2nd/3rd Quartile
Effect on compensation...			
1 year later	0.22 *	0.29	0.24
2 years later	0.14 *	-0.36	-0.42
3 years later	-0.12 *	-0.36	-0.39 *
4 years later	-0.11 *	-0.20	-0.25
5 years later	-0.12 *	-0.08	-0.08
6 years later	-0.16 *	-0.14	-0.15

Source: Farber Report and Backup Materials; Goldman Sachs Data Production

Note: Each row shows the estimated coefficient on a given lag of the indicated pre-2016 outcome. For example, row 1 shows the estimated coefficient on the first lag of pre-2016 360 review score and the first lags of pre-2016 manager quartile placement (estimated using data from the 2016–2018 period). The sample consists of Vice Presidents in Prof. Farber's regression sample from 2016–2018. The regression controls for all variables in Prof. Farber's compensation Model 2. In addition, the regression controls for contemporaneous OMR and manager quartile, lagged OMR and manager quartile received in the Vice President corporate job title for each year in the 2016–2018 period, and lagged 360 review score and manager quartile received in the Vice President corporate job title for each year in the 2010–2015 period. Missing values of each lagged variable are set equal to zero, and for each lagged variable, the model controls for an indicator that equals one if the value of that lagged variable is missing. "*" indicates statistical significance of the coefficient at the 5% level. Standard errors are clustered at the individual professional level.

310. Moreover, Prof. Farber's own methodology implies that effectively *none* of the compensation gap from 2016–2018 can be attributed to these pre-2016 outcomes for 360 reviews and manager quartiling. Exhibit 44 shows the estimated gender gap from 2016–2018 is nearly identical after including these controls for prior 360 review scores and manager quartiles. The table shows that adding controls for current and prior reviews and manager quartiles to Prof. Farber's compensation model changes the gap by *less than three tenths of one percentage point* (moving from row A to row B).[333] My calculation in row C shows that Prof. Farber's own method for attributing compensation gaps to the challenged processes implies that the purported bias in the challenged

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[333] The model in row A includes controls for contemporaneous OMR and manager quartile, since Prof. Farber himself finds no evidence of gender bias in these processes after 2015. The model in row A also controls for the availability of pre-2016 360 review scores and manager quartiles for each professional, but not for the scores or quartiles themselves. This adjustment is necessary in order to isolate the effects of the scores and manager quartiles when comparing row A and row B.

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processes pre-2016 accounts for (at most) a minimal gender difference in compensation 2016–2018 (-0.29 percent).

Exhibit 44

Using Prof. Farber's methodology, pre-2016 360 review scores and manager quartiles explain a minimal share of the 2016–2018 compensation gap

Vice Presidents, 2016–2018

	Estimated Pay Gap
[A] Pay gap from adjusted Farber baseline	-20.25% *
[B] Pay gap after adding controls for 2010–2015 reviews/quartiles	-20.02% *
[C] Pay gap attributable to 2010–2015 reviews/quartiles $= (1 + [A]) / (1 + [B]) - 1$	-0.29%

Source: Farber Report and Backup Materials; Goldman Sachs Data Production

Note: The sample consists of Vice Presidents in Prof. Farber's regression sample from 2016–2018. "*" after estimated pay gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level.

Row A controls for all variables in Prof. Farber's compensation Model 2. In addition, I adjust the regessions by adding controls for contemporaneous OMR and manager quartile, as well as lagged OMR and manager quartile received in the Vice President corporate job title for each year in the 2016–2018 period in which there is lagged OMR and quartile information.

Row B controls for all variables in Row A as well as lagged 360 review score and manager quartile received in the Vice President corporate job title for each year in the 2010–2015 period.

In both models, missing values of each lagged variable are set equal to zero, and for each lagged variable, the model controls for an indicator that equals one if the value of that lagged variable is missing.

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311. A final flaw in Prof. Farber's reasoning is that he misconstrues the relationship between salary and PATC at GS. Prof. Farber's argument that bias in PATC would persist over time is based on his claim that a professional's PATC in a given year affects his or her PATC in the next year.[334] However, the documents he cites only indicate a potential link between future *salary* and past PATC.[335] Prof. Farber assumes, without basis, that a change in salary would necessarily lead to a corresponding change in total compensation in the same year. That need not be true, because bonuses comprise a large share of PATC and can vary widely from year to year.

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[334] Farber Report, ¶ 123 ("As described in paragraph 26 above, if performance ratings explain part of the pay gap prior to 2016, one cannot expect an existing pay gap to disappear even if gender disparities in the rating system are removed. This is because Goldman continues to base future pay on past pay values.").

[335] See Farber Report, ¶ 26 ("Base salary increases in the current year are determined, in part, by prior year PATC."); footnote 15 ("See, for instance 2007 Detailed Compensation Communication Guide for HCM which describes '2008 base salary increases are generally a function of 2007 PATC.'").

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7.3. Prof. Farber's claimed "pay parity" adjustment is inappropriate and his estimate of the aggregate adjustment is inflated

312. In addition to back-pay damages, Prof. Farber claims that certain class members who are still at GS require a one-time "pay parity" adjustment to their PATC. Prof. Farber claims that such an adjustment is needed to redress purported gender disparities in current compensation caused by alleged bias in the challenged processes in 2015 and earlier. Prof. Farber estimates this one-time adjustment in the same way as he estimates back-pay damages in 2019 and 2020.

313. As discussed in the previous subsection, Prof. Farber has no basis to claim that any gender disparities in the review or quartiling process over five years ago has caused any continuing differences in pay. As a result, he has not provided any evidence that there are any ongoing pay disparities that need to be remedied, and therefore he has no basis to conclude that any one-time pay adjustment is appropriate.

314. Even if such an adjustment were necessary, Prof. Farber's calculation would be flawed and improperly inflated. Below, I discuss four such flaws.

315. **Flaw 1:** Prof. Farber's estimated pay adjustment relies on the same flawed models used to calculate back-pay damages. As I explain above, the appropriate pay adjustment is zero, because there is no evidence of systemic bias in the challenged processes.

316. **Flaw 2:** Once again, Prof. Farber makes no attempt to exclude class members without pre-2016 360 VP reviews or manager quartiles, who should be excluded even under Prof. Farber's theory that purported bias in the processes prior to 2016 caused gender disparities in pay after 2015.

317. **Flaw 3:** Prof. Farber makes no effort to account for attrition after 2018 (the last year of the produced data). He simply assumes, without basis, that all VPs who were still at GS at the end of 2018 remained with the firm through 2021. This causes him to overstate the number of class members who would be eligible for any pay adjustment.

318. **Flaw 4:** Prof. Farber does not exclude from his calculation any professionals with arbitration agreements, even those he excluded from his back-pay damages estimates, as described in Section 7.1.

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319. Finally, I note that such one-time pay adjustments may result in duplicative damage awards for their recipients because the class members included in his pay adjustment calculation are also included in his damages calculations for 2020 and the first half of 2021. For example, if back-pay damages for 2020 came in the form of retroactive PATC increases, no further "one-time adjustment" would be required, apart from a potential adjustment to salaries for the remainder of 2021. If the one-time adjustments were instead made in 2021, recipients would receive duplicative damages for the first half of the year (since Prof. Farber's back-pay damages extend through June 2021).

320. For example, consider a hypothetical class member whose expected PATC in 2021 is $1,000 less than it would have been absent the purported bias in the challenged processes (according to Prof. Farber). Prof. Farber would propose giving this class member a one-time pay adjustment of $1,000 in 2021. However, he would also propose awarding that class member $500 in back-pay damages associated with the processes for the first half of 2021. The class member would then receive $1,500 in total damages, when her pay was only $1,000 lower than it would have been absent the alleged misconduct (according to Prof. Farber). Prof. Farber is silent on such double-counting issues between his back-pay damages and his proposed one-time pay adjustment.

7.4. *There are no damages associated with promotion*

321. In Section 5.3, I show there is no evidence of systemic bias in the promotion process. Using the method Prof. Farber uses to analyze the other challenged processes, I find no average gender gap in promotion. If anything, women are promoted significantly more often than men in Securities. **As a result, there can be no damages associated with cross ruffing across the class.**

322. However, if I take Prof. Farber's own flawed regression analysis of promotions and examine his calculations for damages, I find there are further flaws in his analysis.

323. In order to calculate damages associated with any alleged shortfall in promotions, Prof. Farber estimates the number of shortfalls his model would predict in each year of the class period. To do this, he relies on the procedure of using men to predict shortfalls in women's promotions (discussed above), but

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he conducts this procedure in every year instead of cumulatively. He then compares his model's prediction of how many women should have been promoted in each year to how many women were actually promoted in each year to find a yearly shortfall. In some years this difference is positive, indicating that there were fewer women promoted than his model would predict; while in some years this difference is negative, indicating that there *more* women were promoted than his model would predict—producing a shortfall of men (see "Shortfall" column of Exhibit 45).

324. Then, in order to estimate damages associated with each annual shortfall in the number of women promoted, he constructs a measure of the difference in earnings between VPs and EMDs in each year. To do so, he starts by calculating the 90th percentile pay for all women VPs. He then compares this figure to the average pay of all EMDs (regardless of gender). Prof. Farber uses the differences between these two figures to determine the yearly damages associated with a "missed" promotion for each year. More specifically:

- If a female VP missed a promotion to EMD, Prof. Farber assumes that her **but-for pay** would have been the average EMD compensation conditional on tenure, and that her **actual pay** would have been the 90th percentile pay for all women VPs.

- Then, Prof. Farber assumes that her **damages are equal to the but-for minus actual pay** from the year following the missed promotion until she leaves Goldman Sachs.

- Since it is uncertain when someone will leave Goldman Sachs, Prof. Farber takes the "expected" damages from the year following the missed promotion until June of 2021, using an assumed attrition rate.

  » He does this by multiplying the but-for pay minus the actual pay in each year times the probability of an EMD not leaving Goldman Sachs since the time of the missed promotion.

325. Given this description of what Prof. Farber does, **the flaws in his methods are as follows:**

Flaw 1: Prof. Farber uses nonsensical variable to measure VP tenure in the regression model he uses for damages. Prof. Farber writes in his report that his regression includes variables for VP tenure and tenure squared (e.g., two years

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as a VP, two years squared).[336] However, Prof. Farber mistakenly uses two different variables, arbitrary numbers that have nothing to do with tenure, a nonsensical approach.[337] This is a data processing error.

326. **Flaw 2:** A further issue in Prof. Farber's construction of his damages estimates is that while he estimates annual shortfalls in women's promotions, he does not test if these yearly estimates are individually significant. Using Prof. Farber's method for deriving statistical significance across the full set of years, I test whether Prof. Farber's estimated shortfall in *each year* is statistically significant (see "Significant" column of Exhibit 45). I show the results of these tests in Exhibit 45. I find that of the eleven years in which Prof. Farber finds alleged shortfalls in female promotes, only four of those shortfalls are statistically distinguishable from zero using his methods. Note that damages would be negative in 2012, as Prof. Farber's model indicates there was actually a significant shortfall of *men* promoted in that year.

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[336] Farber Report, Table 24 ("The model controls for […] tenure as Vice President at Goldman (and the square of tenure as VP"). Farber Report, ¶ 126 ("I estimate a probit model of the likelihood of promotions as a function of […] number of years as Vice President").

[337] Specifically, Prof. Farber ran his promotion regressions using the date a professional first became VP (e.g., he controlled for March 31, 2003, which is coded as the number "15,795" in his dataset) and that date squared (e.g., he controlled for March 31, 2003 squared, which equals 15,795*15,795 equals 249,482,025 in his dataset).

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Exhibit 45

Statistical significant of Prof. Farber's promotion shortfalls by year

Year	Actual Promotions	Promotions Estimated by Prof. Farber			Shortfall	Significant
		Expected	2.5 percentile	97.5 percentile		
2003	10.0	10.8	8.1	13.8	0.8	No
2004	10.0	10.0	7.1	12.9	0.0	No
2005	13.0	18.4	14.3	22.5	5.4	Yes
2006	0.0	0.0	0.0	0.0	0.0	
2007	28.0	40.2	34.6	46.5	12.2	Yes
2008	0.0	0.0	0.0	0.0	0.0	
2009	15.0	18.1	14.2	22.8	3.1	No
2010	23.0	19.1	14.9	23.5	-3.9	No
2011	13.0	14.9	11.1	18.6	1.9	No
2012	21.0	17.7	15.8	19.5	-3.3	Yes
2013	14.0	14.9	13.3	16.6	0.9	No
2014	0.0	0.0	0.0	0.0	0.0	
2015	29.0	28.3	26.4	30.2	-0.7	No
2016	0.0	0.0	0.0	0.0	0.0	
2017	28.0	35.4	29.5	41.8	7.4	Yes
2018	0.0	0.0	0.0	0.0	0.0	
Total	204.0	227.9			23.9	4 of 11

Source: Farber Report and Backup Materials; Goldman Sachs Data Production

Note: Expected promotions and confidence intervals are calculated using Prof. Farber's promotions model of Section VII and corrected for Vice President tenure control. Prof. Farber incorrectly used the variable "wvpdate," the first day as a Vice President, instead "wvpten," years as Vice President, as the Vice President tenure control in his analysis of promotions.

327. **Flaw 3**: When calculating earnings differences for VPs vs EMDs, he uses the 90th percentile of VP pay across *all* VPs, regardless of tenure. This is an arbitrary and unsupported approach, especially given the wide variation in VP pay across divisions. If you expect only the "best" VPs to be promoted to EMD, you might expect the pay for that group to be higher than the 90th percentile for VPs as a whole. Because Prof. Farber uses a potentially low benchmark (90th percentile of the full population of VPs) for VP pay, his damages calculation likely *underestimates* VP pay, and therefore *overestimates* damages. Choosing the average pay for women VPs who were *actually* promoted may be an alternate benchmark for VP pay, and would reduce Prof. Farber's estimated damages.

328. **Flaw 4:** When estimating the counterfactual pay for female VPs who "should" have been promoted, Prof. Farber uses the average PATC for EMDs. This choice is an important driver of his damages estimate because average (mean) pay for all EMDs is much higher than median pay for EMDs.[338] Mean PATC is much higher than the median PATC because there are EMDs at the top

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[338] From 2003 to 2017, the average EMD pay was $1,930,134 while the median EMD pay was $1,450,000. See "GS CCO - Summary of EMD PATC - 20180913.xlsx".

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of the group who drastically skew the average upwards. By using the mean wage of all EMDs in his calculation instead of the median, Prof. Farber increases his "but-for" PATC and therefore his damages estimates.

329. **Flaw 5:** Prof. Farber does not adequately account for arbitration agreements, making the same errors for supposed promotion damages that I identify in Section 7.1 regarding back-pay estimates. First, Prof. Farber makes a data processing error and incorrectly fails to exclude 278 professionals with severance agreements. Second, he fails to exclude professionals with equity award agreements. Both of these errors cause him to overstate alleged damages.

330. All of these flaws serve to inflate Prof. Farber's estimates of the damages associated with promotion. However, as I stated above, using correct methodology, there are no gender gaps in promotion, and therefore there are zero damages.

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8. CONCLUSION

331. My analyses show that the data strongly reject Plaintiffs' allegation of common, systemic gender bias in the challenged processes at GS. Under Plaintiffs' theory, there should be a pattern of negative, significant gender gaps across *all* groups of decision makers and outcomes that Prof. Farber and I analyze. However, I find that women do just as well as men—and sometimes significantly *better* than men—on many metrics, including 360 scores and manager quartiling in most years and divisions, and promotion from VP to EMD in all three divisions. In addition, Prof. Farber himself has found that there is no evidence of bias in OMRs or in manager quartiling after 2015.

332. Finally, there are no gender gaps in compensation for Associates/Junior Bankers in all three divisions or VPs in Securities. If GS's challenged processes enable systemic discrimination and produce a common gender gap disfavoring women, there should be a clear and consistent pattern of gender gaps adverse to women across all of the challenged processes. This is not the case. In addition, since there is no systemic bias in the challenged processes, such bias could not have caused any gender differences in compensation, and therefore could generate no damages.

Kathryn L. Shaw
March 19, 2021

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9. APPENDIX A – CURRICULUM VITAE AND PRIOR TESTIMONY OF KATHRYN SHAW

CURRICULUM VITAE
KATHRYN L. SHAW
December 2020

Graduate School of Business
Stanford University
Stanford, CA 94305-5015
kathryns@stanford.edu

CURRENT POSITION

Ernest C. Arbuckle Professor of Economics	**2003-present**
BP Faculty Fellow in Global Management	**2020-2021**
Graduate School of Business	
Stanford University	

PREVIOUS ACADEMIC APPOINTMENTS

Visiting Scholar, Brookings Institution	Winter 2020
Visiting Professor, University College London	Spring 2019
Visiting Professor, MIT Sloan	Fall 2018
Visiting Professor, IZA	May 2014
Visiting Professor, University of Paris	December 2009

Tepper School of Business, Carnegie Mellon University

Ford Distinguished Research Chair, Professor of Economics	2002-2003
Professor of Economics	1997-2003
Associate Professor of Economics with Tenure	1994-1997
Associate Professor of Economics	1989-1994
Assistant Professor of Economics	1981-1989

CURRENT PROFESSIONAL LEADERSHIP

Incoming President, then President, Society of Labor Economists	2021-2024
Co-head, NBER Personnel Economics group	2006-present
Co-organizer, CIVOE, Covid international zoom Organizational Economics	2020-present

GOVERNMENT APPOINTMENT

Council of Economic Advisors, Executive Office of the President	1999-2001
Member (Senate confirmed, June 2000), Washington DC	

AFFILIATIONS

Research Associate, National Bureau of Economic Research (NBER)	1995-present
Research Fellow, SIEPR	2016-present
Research Fellow, IZA, Germany	2012-present
Research Fellow, Center for Economic and Policy Research (CEPR), London	2004-2018
Research Fellow, Center for Corporate Performance (CCP), Denmark	2004-2015

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EDUCATION

Harvard University, Ph.D. (Economics)
Occidental College**,** Los Angeles, California, A.B. (Economics, Mathematics)

HONORS

BP Faculty Fellow in Global Management	**2020**
Honorary Doctorate, Maastricht University	**2020**
Co-lead (with Edward Lazear), Personnel Economics group, NBER	2007-present
Graduate School of Business Trust Faculty Fellow	2011-2012
Fellow, Society of Labor Economists	2008
Graduate School of Business Trust Faculty Fellow	2005-2006
Special Award for Sustained Teaching Excellence, Economics Department, CMU	2003
CMU Business School Teaching Award Commendation	1999, 2000, 2002
Columbia University Best Paper on International Business	2001
Minnesota Award for Best Paper on Employment Institutions	1998
Xerox Research Chair, GSIA, Carnegie Mellon University	1992-1993
CMU Department of Economics Teaching Award	1992
Harvard University Graduate Student Fellowship	
Phi Beta Kappa, Magna cum laude, Departmental Honors in Economics,	
4.0 Graduate in Mathematics, Occidental College	
Valedictorian, Verdugo Hills High School	

HONORARY LECTURES

Distinguished Lecturer, Economics, (annual event), Boston University	2021
Joe Tiao Lecturer, Kansas State University	2019
Occidental College 125th Year, Distinguished Alumni Speaker	2012
Distinguished Women in Economics, Washington University	2012
Keynote Speaker, Society of Labor Economists	2012
Guest Lecturer, University of Paris, Science P-O, "What Do CEOs Do?"	2009
Adam Smith Lecture, European Labor Economics Association2008	
Keynote Address, Conference on Education, Training and the Evolving Workplace,	
TARGET, Vancouver, Canada	2006
Bertha Leigh Memorial Lecture, Washington State University	2005
Sloan Industry Studies, Keynote Address, Atlanta	2004
National Defense University, University Address, Washington DC	2004

OTHER PROFESSIONAL EXPERIENCE

Carnegie Mellon University	
Heinz School of Public Policy, Carnegie Mellon University, Affiliated Faculty	1996-2003
Department Head, Industrial Management Department	1987-1990
Department Head, Economics Department (Acting)	1989
Board of Governors of the Federal Reserve	Washington, DC
Visiting Economist	1984-1986
Harvard University	Cambridge, Massachusetts
Assistant Head Tutor in Economics	

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Center for Policy Alternatives   Cambridge, Massachusetts
Massachusetts Institute of Technology

EDITOR AND PROFESSIONAL SERVICE

University of California, Review of Economics group, Haas	2018
German Funding panel (equivalent to NSF), Bonn	2018
Society of Institutional and Organizational Economics, program committee, Montreal	2018
STEP Board, National Academy of Science	2011-2018
Editor, IZA World of Work, Personnel Economics Editor	2012-2017
Board Member, Society of Labor Economists	2013-2015
Editorial Advisory Board Member, *Journal of Economic Perspectives*	2008-2010
Outside Review Panel, Hass School of Business, University of California, Berkeley	2009
The Conference Board, Evidence-Based HR Research Working Group	2007-2009
Bennett Award Committee (chair), AEA, CSWEP	2008-2009
Mincer Award Committee, Society of Labor Economists	2006-2008
John Dunlop Award Committee, Labor and Employment Relations Associations	2006-2008
Associate Editor, *Review of Economics and Statistics*	2003-2011
Editor (Associate), *Journal of Labor Economics*	1999, 2001-2008
Outside Review Panel, Management and Strategy, Kellogg School, Northwestern University	2006
Outside Review Panel, Economics Research Department, Chicago Federal Reserve	2005
NSF Advisory Panel	1997-1999, 2001-2003
American Compensation Association, Academic Research Committee	1997-1999, 2001-2003
IRRA, Labor Economics Subsection, co-chair	1996-1999
Journal of Regional Science, Associate Editor	1994-1997

RESEARCH GRANTS

Smith Richardson Foundation (through NBER)
"Firm Heterogeneity and Income Inequality," April 2014-December 2017, $257,565.
Role: Principal Investigator (with Edward Lazear) Submitted Final Report, fall 2018.

Alfred P. Sloan Foundation
"International Differences in the Business Practices and Productivity of Multinational Firms in Advanced Capitalist Countries" January 2003-2009, $1,000,000.
Role: Principal Investigator (with Richard Freeman)

Alfred P. Sloan Foundation
"Firms, Workers, and Workforce Quality: Implications for Earnings Inequality and Economic Growth,"
January 2003-December 2005, $90,000, principal investigators John Abowd, John Haltiwanger, Julia Lane.

Alfred P. Sloan Foundation, Officers' Planning Grant
"International Differences in the Business Practices and Productivity of Multinational Firms in Advanced Capitalist Countries" June 2002-December 2002 $45,000.
Role: Principal Investigator (with Richard Freeman, Martin Feldstein)

Russell Sage Foundation
"The Impact of Workplace and Technological Innovations on the Demand for Less-Skilled Labor,"
August 1999-September 2002, $300,000.

REDACTED VERSION

Role: Principal Investigator (with Ann Bartel, Casey Ichniowski)

Alfred P. Sloan Foundation
"The Impact of Human Resource Management Practices in the Steel Industry," June 1994-December 2002, $700,000.
Role: Principal Investigator (with Casey Ichniowski)

National Science Foundation
"The Effects of Participatory Human Resource Management Practices on Productivity and Quality in U.S. and Japanese Firms," January 1995-April 1999, $350,000.
Role: Principal Investigator (with Casey Ichniowski)

Department of Labor
"The Impact of HRM Practices on Performance: An International Perspective," October 1994-August 1997, $76,000.
Role: Principal Investigator (with Casey Ichniowski)

National Science Foundation
"The Dynamics of Franchise Contracting," October 1993-October 1995, $98,000.
Role: Principal Investigator (with Francine Lafontaine)

Alfred P. Sloan Foundation
"The Impact of Human Resource Management and Labor Relations Practices in the Global Steel Industry," June 1991-June 1994. Award to project I headed, about $216,000.
Role: Principle Investigator for Human Resource Management component.

W.E. Upjohn Institute for Employment Research
"The Changing Distribution of Family Income and Wealth," January 1991-June 1992, $30,000.
Role: Principal Investigator

National Science Foundation
"Empirical Analysis of the Effects of Risk Aversion on the Investment in Human Capital," June 1987-January 1989, $27,000.
Role: Principal Investigator

Social Impact of Information and Robotics Technology
Carnegie Mellon University, supporting work on "Individual Adjustment to Structural Change," 1983-1984, $20,000.
Role: Principal Investigator

Doctoral Dissertation Grant, US Department of Labor.

TEACHING EXPERIENCE

MBA Courses, Stanford University
The Impact of AI on Productivity and Personal Performance
Inclusive Economic Growth and Poverty Reduction in Developing Countries
People Management Strategy
Organizational Strategy
Contemporary Economic Policy
Making Data Relevant
Data Driven Human Resource Strategy
Managing Talent

REDACTED VERSION

Entrepreneurship from the Perspective of Women (pre-term with Garth Saloner)
Human Resource Management Strategy
Productivity and Incentives (with Ed Lazear)

MBA Courses, Carnegie Mellon University
Macroeconomics
Internal Strategy of Firms
Topics in Labor Market Analysis
The Changing Global Environment and the Wealth of Nations

Undergraduate Courses, Carnegie Mellon University
Managing in the Information Economy
Markets, Incentives, and Value
Labor Economics
Labor and Manpower
Industrial and Labor Relations
Intermediate Macroeconomics

Ph.D. Courses
Personnel Economics   Stanford University
Faculty Research Workshop
Doctoral Seminar in Labor Economics   Carnegie Mellon University

Executive Education
SEP turbo lecture   2019
SEP turbo lecture   2018
Lecture for Chinese executives
GSB Summer Institute (Co-Director)   2004-2017
Citigroup Executive Program
Sloan Executive Program
HR Executive Program
Alumni Weekend, Events

STUDENT SUPERVISION
Thesis committees, recent – Hugh Wu, Shannon Liu   2018-2019
Thesis advisors, Sara Champion (chair), Chris Stanton (chair)   2006-present
    James Liang, Brianna Cardiff-Hicks (chair)
Outside Committee Head, Education Dept, Stanford, Anna Mastri   2006
Outside Committee Head, Economics Dept, Stanford, Kelly Russell   2005
Ph.D. Thesis Chairman – Zili Zhuang, Brent Boning, Jonathon Gant,   1986-2003
Carnegie Mellon University - Linda Christie, Giovanna Prennushi,
    Mary Ellen Benedict, Renee Fields

PUBLICATIONS - Journal Articles

"Coming of Age: How Young Entrepreneurs Become Successful and Serious," with Anders Sorensen, *Labour Economics*, R&R, October 2020.

"The Productivity Advantage of Serial Entrepreneurs," with Anders Sorensen, *Industrial and Labor Relations Review*, 72(5), October 2019: 1225-1261.

REDACTED VERSION

"Who Gets Hired? The Importance of Finding an Open Slot," with Edward Lazear and Christopher Stanton, *Journal of Labor Economics*, 36(S1), January 2018: S133-S181.

"Introduction: Firms and the Distribution of Income: The Roles of Productivity and Luck," with Edward Lazear, *Journal of Labor Economics*, 36(S1), January 2018: S1-S12.

"Serial Entrepreneurship: Learning By Doing?" (with Francine Lafontaine), *Journal of Labor Economics*, 34(2) (2016): S217-S254.

"Incentives for Lawyers: Moving Away from "Eat-What-You-Kill," (with Ann Bartel and Brianna Cardiff-Hicks), *Industrial and Labor Relations Review*, 70(2), March 2017.

"Making Do with Less: Why Productivity is Rising During Recessions," (with Edward Lazear and Christopher Stanton), *Journal of Labor Economics*, 34(1) January 2016: S333-S360.

"The Value of Bosses," (with Edward Lazear and Christopher Stanton), *Journal of Labor Economics,* 33 (4), October 2015: 823-862.
  Runner up H. Gregg Lewis Prize for best paper in the previous two years of *Journal of Labor Economics*

"Do Large Modern Retail Firms Pay Wage Premia?" (with Brianna Cardiff-Hicks and Francine Lafontaine), *Industrial and Labor Relations Review*, 68 (3) (May 2015): 633-665.

"A Personnel Economics Approach to Productivity Enhancement," (with Edward Lazear), *Nordic Economic Policy Review,* 2 (2011).

"Insider Econometrics: A Roadmap with Stops Along the Way," *Labour Economics*, 2009.

"Reaching for the Stars: Who Pays for Talent in Innovative Industries?" (with Fredrik Andersson, Matthew Freedman, John Haltiwanger, Julia Lane), *Economic Journal,* 119 (June 2009): 308-332.

"Tenure and Output," (with Edward Lazear), *Labour Economics*, 15 (2008): 710-724.

"Personnel Economics: The Economist's View of Human Resources," (with Edward Lazear) *Journal of Economic Perspectives*, 21 (4), (Fall 2007): 91-114.

"How Does Information Technology affect Productivity? Plant-Level Comparisons of Product Innovation, Process Improvement and Worker Skills," (with Ann Bartel and Casey Ichniowski), *Quarterly Journal of Economics*, 122 (4), (November 2007): 1721-1758.

"Opportunity Counts: Teams and the Effectiveness of Production Incentives," (with Brent Boning and Casey Ichniowski), *Journal of Labor Economics* 25 (2007): 613-650.

"Targeting Managerial Control: Evidence from Franchising," (with Francine Lafontaine), *Rand Journal of Economics* 36 (1) (Spring 2005): 131-150.

"Beyond Incentive Pay: Insiders' Estimates of the Value of Complementary Human Resource Management Practices," (with Casey Ichniowski), *Journal of Economic Perspectives*, 17 (1) (Winter 2003): 155-178.

"Social Capital and Organizational Change in High-Involvement and Traditional Work Organizations," (with Jon Gant and Casey Ichniowski), *Journal of Economics and Management Strategy,* 11 (2) Summer 2002: 289-328.

REDACTED VERSION

"Industrial Change and Wage Inequality: Evidence from the Steel Industry" (with Patricia Beeson and Lara Shore-Sheppard), *Industrial and Labor Relations Review*, 54 (March 2001): 466-483.

"The Dynamics of Franchise Contracting: Evidence from Panel Data" (with Francine Lafontaine), *Journal of Political Economy*, 107 (October 1999): 1041-1080.

> Reprinted in *Empirical Industrial Organization*, Paul Joskow and Michael Waterson, Eds., Cheltenham, UK: Edward Elgar Publishing, Ltd., (forthcoming), and in *The International Library of the New Institutional Economics*, Claude Menard, Ed., UK: Edward Elgar Publishing, Ltd., (forthcoming).

"The Effects of Human Resource Systems on Productivity: An International Comparison of U.S. and Japanese Plants" (with Casey Ichniowski), *Management Science*, 45 (May 1999): 704-722.

"The Effects of Human Resource Management Practices on Productivity" (with Casey Ichniowski and Giovanna Prennushi), *American Economic Review*, 86 (June 1997): 291-313.

> Reprinted in *Personnel Economics*, Edward P. Lazear and Robert McNabb, Eds., Cheltenham, UK: Edward Elgar Publishing, Ltd.

"Pensions and Wage Premia" (with Edward Montgomery), *Economic Inquiry*, 35 (July 1997): 510-522.

"Franchising Growth and Franchiser Entry and Exit in the U.S. Market: Myth and Reality" (with Francine Lafontaine), *Journal of Business Venturing*, Special Issue on Franchising (1997).

"An Empirical Analysis of Risk Aversion and Income Growth," *Journal of Labor Economics*, 14 (October 1996): 626-653.

"Old Dogs and New Tricks: Determinants of the Adoption of Productivity-Enhancing Work Practices" (with Casey Ichniowski), *Brookings Papers on Economic Activity*: *Microeconomics* (1995): 1-65.

"The Impact of Pension Benefits on the Distribution of Earned Income" (with Mary Ellen Benedict), *Industrial and Labor Relations Review*, 48 (July 1995): 740-757.

"The Life-Cycle Persistence of Female Labor Supply," *Journal of Human Resources*, 29 (Spring 1994): 348-378.

"The Distribution of Family Income and Benefits" (with Mary Ellen Benedict), *Ohio Journal of Economics and Politics* (1994).

"Unanticipated Aggregate Disturbances and Tests of the Life-Cycle Consumption Model Using Panel Data" (with Randall Mariger), *Review of Economics and Statistics*, 75 (February 1993): 48-56.

"The Life-Cycle Labor Supply of Married Women and Its Implications for Household Income Inequality," *Economic Inquiry*, 30 (October 1992): 659-672.

"Pensions and Wages: An Hedonic Price Theory Approach" (with Edward Montgomery and Mary Ellen Benedict), *International Economics Review*, 33 (February 1992): 111-128.

"The Effects of Skill Investment on Migration and Industry Change," *Journal of Regional Science*, 31 (November 1991): 397-416.

REDACTED VERSION

"Intertemporal Labor Supply and the Distribution of Family Income," *Review of Economics and Statistics*, 71 (May 1989): 196-205.

"Life-Cycle Labor Supply with Human Capital Accumulation," *International Economic Review*, 30 (May 1989): 431-456.

"Wage Variability in the 1970's: Sectoral Shifts or Cyclical Sensitivity?" *Review of Economics and Statistics*, 71 (February 1989): 26-36.

"Disaggregate Estimates of the Real Wage-Employment Relationship" (with Edward Montgomery), *Economic Letters*, 26 (1988): 241-246.

"The Quit Propensity of Married Men," *Journal of Labor Economics*, 5 (October 1987): 533-560.

"Occupational Change, Employer Change, and the Transferability of Skills," *Southern Economic Journal*, 54 (January 1987): 702-719.

"Long Term Contracts, Expectations and Wage Inertia" (with Edward Montgomery), *Journal of Monetary Economics*, 16 (September 1985): 209-226.

"A Formulation of the Earnings Function Using the Concept of Occupational Investment," *Journal of Human Resources*, 19 (Summer 1984): 319-340.

PUBLICATIONS - Articles in Books

"Insider Econometrics: Empirical Studies of How Management Matters" (with Casey Ichniowski), *Handbook of Organizational Economic*, Eds. Robert Gibbons and John Roberts, Princeton University Press, 2013: 263-311.

"Zooming in and Zooming Out: Rethinking the "Conspiracy of Dysfunction" in School District Human Resource Management" (with Michael DeArmond and Patrick Wright), in Dan Goldhaber and Jane Hannaway, Eds., *Creating a New Teaching Profession,* Urban Institute Press, 2009.

"Jobs Online" (with Alice Nakamura, Emi Nakamura, Richard Freeman, Amanda Pyman), *Studies of Labor Market Intermediation*, Editor, David Autor, University of Chicago, National Bureau of Economic Research, 2009.

"Wage Structure, Wages, and Mobility" (with Edward Lazear), 2009. *The Structure of Wages: An International Perspective*, Edward Lazear and Kathryn Shaw, Eds., University of Chicago, National Bureau of Economic Research, 2009.

"International Differences in the Adoption and Impact of New Information Technologies and New HR Practices: The Valve-Making Industry in the U.S. and U.K." (with Ann Bartel, Casey Ichniowski, Ricardo Correa), *International Differences in the Business Practices and Productivity of Firms*, Richard Freeman and Kathryn Shaw, Eds., University of Chicago, National Bureau of Economic Research,.2007.

"Wage Structure, Wages, and Mobility: An Overview" (with Edward Lazear), in Alex Bryson and J.Forth, and Catherine Barber, *Making Linked Employer-Employee Data Relevant to Policy*, DTI Economics Paper, Department of Trade and Industry, London, April 2006: 9-27.

"The Value of Innovative HRM Practices," in Eds. Edward Lawler and James O'Toole, *Work in America*. August 2006: 227-240.

REDACTED VERSION

"The Human Resources Revolution: Is it a Productivity Driver?, in Adam Jaffe, Josh Lerner, and Scott Stern, *Innovation, Policy and the Economy*, Chicago: University of Chicago, National Bureau of Economic Research, 2003: 69-114.

"'New Technology' and Its Impact on the Jobs of High School Educated Workers: A Look Deep Inside Three Manufacturing Industries" (with Ann Bartel and Casey Ichniowski), in Eileen Appelbaum, Annette Bernhardt, and Richard Murnane, Eds., *Low Wage America*, New York: Russell Sage Foundation, 2003: 155-194.

"Technology Shocks and Problem-solving Capacity," in Donna Ginther and Madeline Zavodny, Eds., *Technology, Growth, and the Labor Market*, Boston: Kluwer Academic Publishers, 2003: 235-258.

"By What Means Does Information Technology Affect Employment and Wages?" in Nathalie Greenan, Yannick L'Horty, and Jacques Mairesse, Eds., *Productivity, Inequality, and the Digital Economy: A Transatlantic Perspective*, Cambridge: MIT Press, 2002.

"TQM Practices and Innovative HRM Practices: New Evidence on Adoption and Effectiveness" (with Casey Ichniowski) in Robert Cole and Richard Scott, Eds., *The Quality Movement in America: Lessons from Theory and Research*, Russell Sage, 2000: 347-366.

"The Incentives of Quality and the Quality of Incentives: Quality Improvement and Incentive Pay for Frontline Workers" (with David Levine) in Robert Cole and Richard Scott, Eds., *The Quality Movement in America: Lessons from Theory and Research*, Russell Sage, 1999: 367-386.

BOOKS AND VOLUMES EDITED

Firms and the Distribution of Income, Editors Edward Lazear and Kathryn Shaw, Special issue, *Journal of Labor Economics*, 2018.

The Analysis of Firms and Employees: Quantitative and Qualitative Approaches, Editors Stefan Bender, Julia Lane, Kathryn Shaw, Fredrik Andersson, and Till Von Wachter, University of Chicago Press, National Bureau of Economic Research, 2008.

The Structure of Wages: An International Comparison, Editors Edward Lazear and Kathryn Shaw, University of Chicago Press, National Bureau of Economic Research, 2009. (Book listed as Noteworthy Books in Industrial Relations and Labor Economics for 2009 by the Industrial Relations Section, Princeton University.)

International Differences in the Business Practices and Productivity of Firms, Editors Richard Freeman and Kathryn Shaw, University of Chicago, National Bureau of Economic Research, 2009.

Co-editor, *Journal of Labor Economics* special issue on "Compensation Strategies" (with George Baker and Abbie Smith), March 2002.

Co-editor, *Journal of Human Resources* special issue on "The Economics of Women and Children" (with Alice Nakamura), 29 (Spring 1994).

DISCUSSION IN BOOKS

Discussion commentary, *Managing Capital in the New Economy,* edited by Carol Corrado, John Haltiwanger, and Dan Sichel, National Bureau of Economic Research, 2003.

REDACTED VERSION

Discussion commentary, *The New Relationship: Human Capital in the American Corporation,* edited by Margaret Blair and Thomas Kochan. Washington, D.C., Brookings Institution, 1999.

BOOK REVIEWS

Review of Harry C. Katz *Shifting Gears: Changing Labor Relations in the US Automobile Industry*, in *Southern Economic Journal*, 53 (October 1986): 299-300.

PAPERS AND PROCEEDINGS

"Using 'Insider Econometrics' to Study Productivity," *American Economic Association Papers and Proceedings*, 94 (May 2004): 217-223.

"Women's Contribution to Productivity," *Regional Review*, Federal Reserve Bank of Boston, 14(3), Q1 2005: 44-48.

"Technology Shocks and Problem-Solving Capacity," *Economic Review*, Federal Reserve Bank of Atlanta*, 2002.

"The Relentless Search for Efficiency in the Workplace" *Proceedings of the 53rd Annual Meeting of the National Academy of Arbitrators*, Washington, D.C.: Bureau of National Affairs, 2001.

"Getting the Job Done: HRM and the Production Function" (with Jon Gant, Casey Ichniowski), *Industrial Relations Research Association Proceedings*, 1999: 43-52.

"The Adoption of HRM and TQM Practices and Their Effects on Performance in U.S. and Japanese Steel Lines," *Proceedings of the 1997 NSF Design and Manufacturing Grantees Conference*, Seattle, WA, Society of Manufacturing Engineers, 1997: 659-670.

"The Effects of Participatory Human Resource Management Practices on Productivity and Quality in U.S. and Japanese Firms," *Proceedings of the 1996 NSF Design and Manufacturing Grantees Conference*, Dearborn, MI, Society of Manufacturing Engineers, 1996: 613-614.

WORKING PAPERS

"Spurring Serious Entrepreneurship: A Policy Experiment to Lower Entry Costs" with Anders Sorensen, 2020

"Firm-level Shocks and the Volatility of Worker Earnings within Megafirms," Chinhui Juhn, Kristin McCue, Brooks Pierce, October 2018.

"Unraveling the Mystery of Megafirm Success: Do the Internal HR Practices of Megafirms Differentiate Them?" Chinhui Juhn, Kristin McCue, Brooks Pierce, October 2018.

"Serious Entrepreneurs as Serial Entrepreneurs: What Accounts for Their Success?" with Anders Sorensen, July 2018.

"The Intangible Capital of Young Serial Entrepreneurs," with Anders Sorensen, April 2017.

"The Economic Integration of Hispanics: Evidence from Retail," with Rebecca Diamond and Francine Lafontaine, ongoing.

"The Rise of Fast Food in Poor and Hispanic Neighborhoods," with Francine Lafontaine, 2016.

REDACTED VERSION

"The Teachers Who Leave: Pulled by Opportunity or Pushed by Accountability?" with Sara Champion, September 2011.

"Teachers' Pay Compression: Leaving for Opportunity?" with Anna Mastri and Sara Champion, September 2010.

"Connective Capital as Social Capital: The Value of Problem-Solving Networks for Team Players in Firms, with Casey Ichniowski, NBER working paper #15619, December 2009.

"Insider Econometrics: Empirical Studies of How Management Matters," NBER Working Paper #15618, December 2009.

"People Management Practices and Productivity," October 16, 2009.

"What do Bosses Do?" working Paper, September 2009.

"Wage Compression and Teacher Quality," with Anna Mastri and Sara Champion, January 2008.

"Talent Sorting and Skill Complementarity Among Software Engineers" (with Frederik Andersson, Matthew Freedman, John Haltiwanger, Paul Oyer), January 2007.

"Connective Capital: Building Problem-Solving Networks Within Firms" (with Casey Ichniowski), revised April 2005.

"Technology Shocks and Problem-Solving Capacity," March 2002.

"Productivity in the New Economy," (speech) September 2000.

"Innovative Human Resource Practices and Workplace Efficiency," (speech) July 2000.

"Innovative HRM Practices as a Technology Shock: Building 'Problem-Solving Capacity' in Production Workers," for presentation at conference on Technology, Regulation, and Employment, sponsored by CEMFI, Madrid, June 1999.

"The Evolution Towards High-Involvement Organizations: Distinguishing Differences in Workers' Networks" (with Jon Gant and Casey Ichniowski), April 1999.

"HRM Practices, Knowledge Capital, and the Changing Access to 'Good' Jobs," June 12, 1998.

"Labor Supply, Human Capital Accumulation, and the Changing Distribution of Family Income," 1996.

"Firm-Specific Fixed Effects in Franchise Contracting: Sources and Implications" (with Francine Lafontaine), December 1995.

"Investment in Industry Skills: Implications for Wage Growth and Worker Displacement," December 1993.

"Labor Supply and Taxes: Estimates from a Life-Cycle Model Produce a Pessimistic View of Estimation Possibilities," December 1992.

"Labor Supply and Taxes, 1967-1987" (with Randall Mariger), December 1991.

REDACTED VERSION

REFEREE

American Economic Review, Canadian Journal of Economics, Eastern Economic Journal, Economic Inquiry, Economic Journal, Economics of Education Review, Industrial Relations, International Economic Review, International Journal of Manpower, Journal of Applied Econometrics, Journal of Economics and Management Strategy, Journal of Financial Economics, Journal of Human Resources, Journal of Labor Economics, Journal of Law and Economics, Journal of Macroeconomics, Journal of Money Credit and Banking, Journal of Political Economy, Journal of Regional Science Management Science, Quarterly Journal of Economics, Review of Economic Studies, Review of Economics and Statistics, Social Science Quarterly, Southern Economic Journal - National Science Foundation.

BUSINESS SCHOOL CASES

"Synapse Technologies: Entrepreneurship with AI," James Jedras, Kathryn Shaw, 2021
"Focal Systems: AI Moving Into Retail," James Jedras, Kathryn Shaw, 2021
"Royal Bank of Canada: Using People Strategy and Analytics to Drive Employee Performance"
  (A) and (B), 2017, with Debra Schifrin.
"LinkedIn and Modern Recruiting" (A) and (B), 2015, with Debra Schifrin.
"Box:b The Evolution of Management Practices in a Start-up," 2015, with Debra Schifrin.
"Royal Bank of Canada: Transforming Managers" (A) and (B), 2015, with Debra Schifrin.
"Performance Evaluations: Bialecki Inc.," 2008, with Katherine Bose.
"Shiny and New: The Evolution of ISG and ArcelorMittal Steel," 2008, with Katherine Bose.
"Cinepolis: Changes to a Family-Owned Company," 2007, with Bethany Coates.
"Amy Baker," 2005, with Dani Kerrigan, Joanna Newman, and Alex Tauber.
"Sheryle Bolton (A)," 2005, with Carly Irestone, Angela Shelton, and Alex Tauber.

SERVICE ON COMMITTEES

GSB, Stanford University Committees:
  Lazear-Liang Committee (2020-)
  FAB Subcommittee (2020-)
  Faculty Senate (2016-2017)
  Mexico Study Trip (2017)
  Argentina/Peru MBA Study Trip (2016)
  Brazil MBA Study Trip (2015)
  University Committee on Graduate Studies (2013-2018)
  University Committee on Faculty Staff Human Resources (2013-2018)
  Data Center Report (2011-2012)
  Management-X Committee (2011-2012)
  Kenya MBA Study Trip (2012)
  Academic Coordinating Committee (2010-present)
  Faculty Liaison GSB Student Newspaper (2010-2011)
  University Committee on Evaluation of Human Resources (2009-2010)
  Committee on Faculty Staff Human Resource (2007-2009)
  Co-Director, Stanford GSB Summer Institute (2004-present)
  Philippines MBA Study Trip (2006)

Carnegie Mellon University Committees:
  Budget and Finance Committee (2002-2003)
  Chairman, Faculty Senate (1999)
  Presidential Review Committee: The Social Sciences (1999)
  University First Year Council (1996-1999)

REDACTED VERSION

President's Lecture Series Committee, (1998-1999)
Faculty Affairs Council (1996-1998) (Chair, 1996-1997)
Vice-Chairman, Faculty Senate (1998-1999)
Advising Award Committee (Co-chair) (1994-1997)
Advisory Committee for the Undergraduate Teaching Center (1992-1998)
Advisory Board of the Center of the Study of African Americans (1994-1998)
Executive Committee of the Faculty Senate (1996-1997)
Committee on Non-Tenured Appointments (1995-1996)
Senator for Faculty Senate (1994-1995)
University Parking Committee (1994-1995)
University Education Council (with new structure) (1993-1995)
Committee on Faculty Promotion and Tenure Policy (1993-1994)
Graduate Student Luncheon Series (presentation) (1994)
Committee on Flexible Rates for Employees (1994)
Selection Committee for University Award for Academic Advising (1993-1994)
"97 Network" Orientation (1993)
Human Relations Commission (1989-1992)
Committee on Academic Support Services (1991-1992)
H&SS Dean's Search Committee (1991-1992)
Committee on Non-tenured Appointments (1990-1992)
Ryan Award Committee (1989-1990) (1991-1992)
Teaching Center Orientation presentations (1992)
Advisory Committee on Family and Work (1989-1991)
Retention Committee (1990-1991)
Watson Fellowship Committee (1990-1991)
Flexible Benefits Advisory Group (1989-1990)
Educational Facilities Committee (1989-1991)
Gender Studies Committee, H&SS (1988-1989)
H&SS Subcommittee on Internships (1988-1989)
Fulbright Committee (1989-1990)
University Education Council (1987-1990)
Associate Deans Council (1987-1990)

CMU, Graduate School of Industrial Administration, Committees:
MBA Curriculum Review Committee (2003)
GSIA Executive Education Faculty Advisory Board (2003)
Faculty MBA Funding Committee (2003)
Dean's Advisory Committee (2002-2003)
Engineering/MBA Planning Committee (chair), (2002-2003)
BS/BA Academic Actions Committee (2001-2003)
IM Policy Committee (1987-2003)
Strategy Recruiting Committee, (2001-2002)
MBA Curriculum Committee, (2001-2002)
Co-organizer CMU - University of Pittsburgh Applied Micro Workshop (1995-1999)
Economics Review Committee (1998)
Management Game Board (1981-1998, most years)
Dean's Advisory Council (1997)
Subcommittee on Sabbaticals (1996)
GSIA Committee on Women (Chair) (1994-1995)
Subcommittee Head, Tracks in IM (1992-1993)
IM Curriculum Review Committee (1991-1992)
Economics Curriculum Committee (1991-1992)
Advisory Committee on Undergraduate Economics (1990-1992)

REDACTED VERSION

ORGANIZATION OF CONFERENCES OR SESSIONS

Conference Co-Organizer, NBER Personnel and Labor Studies, Summer Institute, July 2019.
Conference Co-Organizer, "The Rise of the Mega-firm: Causes and Consequences for Labor and Product Markets," NBER, MIT, October 2018.
Conference Co-Organizer, NBER Personnel and Labor Studies, Summer Institute, July 2018.
Conference Co-Organizer, NBER Personnel and Labor Studies, Summer Institute, July 2017.
Conference Organizer, "Firm Heterogeneity and Income Inequality," Stanford, September 2016.
Conference Co-Organizer, NBER Personnel and Labor Studies, Summer Institute, July 2016.
Conference Co-Organizer, NBER Personnel and Labor Studies, Summer Institute, July 2015.
Conference Committee, Society of Labor Economics, 2015.
Conference Co-Organizer, NBER Personnel and Labor Studies, Summer Institute, July 24-25, 2014.
Conference Co-Organizer, NBER Personnel and Labor Studies, Summer Institute, July 27-28, 2013.
Conference Co-Organizer, NBER Personnel and Labor Studies, Summer Institute, July 26-27, 2012.
Conference Co-Organizer, NBER Personnel and Labor Studies, Summer Institute, July 28-30, 2011.
Conference Co-Organizer, NBER Personnel and Labor Studies, Summer Institute, July 27-30, 2010.
Conference Organizer, NBER Personnel and Labor Studies, Summer Institute, July 26-30, 2009.
Conference Organizer, NBER Personnel and Labor Studies, Summer Institute, July 30-31, 2008.
Conference Organizer, NBER Personnel and Labor Studies, Summer Institute, July 29-30, 2007.
Conference Co-Organizer and Sponsor, Conference on Firms and Employers, Ammersee, Germany, September 2006.
Conference Organizer, NBER Summer Institute, Personnel Economics, Cambridge, July 28, 2006.
Conference Co-Organizer, International Differences in the Business Practices and Productivity of Firms, Stanford University, January 19-20, 2005.
Conference Co-Organizer, "21st Century Human Resource Management Practices and Their Effects on Firms and Workers," University of Illinois, November 11-12, 2005.

SEMINAR OR CONFERENCE PRESENTATIONS

Seminar or Conference Presentations, 2020-21

"Spurring Serious Entrepreneurship: A Policy Experiment to Induce LLC Entry" with Anders Sorensen
    Boston University, economics seminar, March 2020
    Kellogg School of Management, Northwestern University, March 2020
    Duke University, Strategy Group, March 2020

Keynote address, "The Value of Managers and Management Practices: What Do We Know and Where are We Going?" Cedefop, Eurofound and IZA Conference: Workplace and Management Practices. (Conference was planned for Dublin, Ireland.)

"Spurring Serious Entrepreneurship: A Policy Experiment to Lower Entry Costs" with Anders Sorensen
    EALE/SOLE meetings June 2020
    Maastricht University, February 2020

Seminar or Conference Presentations, 2019

World Economic Forum, Global Future Council on the New Equality and Inclusion Agenda, Dubai, November 2019.

Discussant, Jackson Hole NBER conference on "Incentives and Limitations of Employment Policies on Retirement Transitions," August 2019.

REDACTED VERSION

"The Effectiveness of HR Practices: Evidence from Insider Econometrics," Keynote, IOEA, Corsica, May 2019.

"Spurring Serious Entrepreneurship: A Policy Experiment to Lower Entry Costs" with Anders Sorensen
    University of Illinois, economics seminar, October 2019
    National University of Singapore, October 2019
    Joe Tiao Lecturer, seminar, Kansas State University, November 2019
    Goethe University, Frankfurt, June 2019
    LMU, Munich, June 2019
    LSE, London, May 2019
    University College London, London, May 2019

"Unraveling the Mystery of Megafirm Success: Do the Internal HR Practices of Megafirms Differentiate Them?" with Chinhui Juhn, Kristin McCue, Brooks Pierce
    Trans Pacific Labor Seminar, Tokyo, Japan, May 2019

"Management in the New Age of AI: An Economist's Perspective" (talk, but not paper)
    Joe Tiao Lecturer, public lecture, Kansas State University, November 2019
    Copenhagen Business School, conference for Niels Westergard-Nielson, January 2019

Seminar or Conference Presentations, 2018

"The Productivity Advantage of Serial Entrepreneurs," with Anders Sorensen
    Queens University, September 2018.
    Society of Labor Economics, Toronto, May 2018.
    Society of Institutional and Organizational Economics, Montreal, May 2018.

"Unraveling the Mystery of Megafirm Success: Do the Internal HR Practices of Megafirms Differentiate Them?" with Chinhui Juhn, Kristin McCue, Brooks Pierce
    Seminar, Australian National University, December, 2018.
    Personnel Economics Workshop meeting, Universidad de Los Andes, December 2018.

"Serious Entrepreneurs as Serial Entrepreneurs: What Accounts for Their Success?" with Anders Sorensen
    Society of Institutional and Organizational Economics, 2018.
    Seminar, MIT, Innovation and Entrepreneurship seminar workshop, September 2018.
    Trans Pacific Labor Studies, UCLA, October, 2018.

"The Intangible Capital of Young Serial Entrepreneurs" with Anders Sorensen
    Boconni University, CEPR, September 6-7, 2018.

"Management in the New Age of AI: An Economist's Perspective" (talk, but not paper)
    NBER Conference on AI, August 2018.
    Management Workshop, Universidad de Los Andes, December 2018.

Discussant, NBER Organizational Economics, Society for Institutional and Labor Economics (Montreal), May 2018.

Seminars or Conference Presentations, Recent Years through 2017

2017: AEA, Copenhagen Business School, NBER Organizational Economics (Boston); Leadership Conference (Barcelona); University of Groningen, NBER Summer Institute Entrepreneurship; NBER

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Hong Kong Meeting on Entrepreneurship, AASLE (Australia), Carnegie Mellon University, Stanford workshop, Stanford U.S/Japan conference.

2016: AEA (Boston), Copenhagen Business School, Trans Pacific Labor Studies (Santa Barbara), Kellogg Northwestern, Society of Labor Economists (Seattle), University of Maryland, NAS Conference on Entrepreneurship, University of Toronto, NBER Organizational Economics, Stanford Faculty Workshop, IZA, Erasmus University, Stanford "Bright Spots"

Recent reports or testimony: (last 4 years)

Press Ganey Associates, Inc., v. Qualtrics Arbitration, Durie Tangri, 2019

"Assessment of the Unionization Risk to Lyft," Lyft Inc, for Brattle Consulting, 2019.

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10. APPENDIX B – DOCUMENTS CONSIDERED

Document Title	Document Date
Legal Pleadings	
Class Certification Hearing	October 22, 2014
Memorandum and Order on Motions to Exclude Expert Testimony	March 10, 2015
Memorandum in Support of Plaintiffs' Motion for Class Certification	July 1, 2014
Opinion and Order Granting in Part Plaintiffs' Motion to Certify the Class Pursuant to Rule 23(b)(3), ECF No. 578	March 30, 2018
Plaintiffs' Responses and Objections to Defendants' Third Set of Interrogatories	April 10, 2019
Depositions and Declarations	
Declaration of Celeste Guth	June 30, 2014
Declaration of Clare Scherrer	July 26, 2014
Declaration of Craig Packer	July 2, 2014
Declaration of Darren Cohen	July 1, 2014
Declaration of Darren Cohen	May 23, 2018
Declaration of David Landman	June 5, 2015
Declaration of David Landman	May 26, 2017
Declaration of David Landman	October 13, 2017
Declaration of Donald Casturo	June 27, 2014
Declaration of Henry Farber	June 6, 2018
Declaration of Henry Farber	June 29, 2018
Declaration of Jacqueline Cassidy	May 23, 2018
Declaration of Jacqueline Cassidy	October 19, 2020
Declaration of James McNamara	June 30, 2014
Declaration of Joanna Kozlowski	November 28, 2020
Declaration of Kathleen Cupertino	November 12, 2020
Declaration of Megan Taylor	June 30, 2014
Declaration of Michael Ward	October 13, 2017
Declaration of Michael Ward	May 23, 2018
Declaration of Stephen Pierce	July 2, 2014
Declaration of Susan Benz	July 3, 2014
Declaration of Todd Lopez	July 1, 2014
Deposition of Bruce Larson and exhibits	June 12, 2013
Deposition of Caroline Heller Sberloti, Volume I	July 10, 2013
Deposition of Caroline Heller Sberloti, Volume II	July 11, 2013

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Document Title	Document Date
Deposition of David Landman and exhibits	September 5, 2013
Deposition of David Landman and exhibits	April 3, 2018
Deposition of Edith Hunt	September 30, 2020
Deposition of Jessica Kung, Volume I	July 31, 2013
Deposition of Jessica Kung, Volume II	August 1, 2013
Deposition of Scott Mehling	May 20, 2013
Deposition of Stephanie Blinder	April 30, 2013

Expert Reports

Expert Rebuttal Report of Henry S. Farber and backup materials	January 28, 2014
Expert Rebuttal Report of Henry S. Farber and backup materials	July 29, 2014
Expert Report of Henry S. Farber and backup materials	October 30, 2013
Expert Report of Henry S. Farber and backup materials	February 17, 2014
Expert Report of Henry S. Farber and backup materials	January 15, 2021
Expert Report of Michael P. Ward and backup materials	December 13, 2013
Expert Report of Michael P. Ward and backup materials	July 3, 2014
Expert Report of Michael P. Ward and backup materials	August 29, 2018
Expert Report of Wayne F. Cascio	January 15, 2021
Expert Sur-Rebuttal Report of Michael P. Ward and backup materials	May 7, 2014
Second Expert Rebuttal Report of Henry S. Farber and backup materials	May 19, 2014

Other Produced Documents

"2000 MD & PCP Selection Cross-ruffing Orientation Meeting," GS0113568 – 89	2000
"2001 MD Selection Cross-ruffing Orientation Meeting," GS0113531 – 47	2001
"2002 MD & PCP Selection Cross-ruffing Workshop," GS0113548 – 67	2002
"2003 Firmwide Review Process – FAQs," GS0119399 – 401	2003
"2003 MD Selection Cross-ruffing 'Best Practices' Workshop," GS0109256 – 72	2003
"2004 MD Selection Cross-ruffing 'Best Practices' Workshop," GS0109329 – 49	2004
"2005 MD Selection Cross-ruffing 'Best Practices' Workshop," GS0109273 – 98	2005
"2006 Partner and MD Selection Cross-ruffing 'Best Practices' Workshop," GS0109299 – 328	2006
"2006 Performance Reviews," GS0120195 – 225	2006
"2006 Performance Reviews," GS0120854 – 88	2006
"2006 Performance Reviews," GS0121404 – 26	2006
"2007 Detailed Compensation Communication Guide For HCM," GS0113786 – 807	2007
"2007 MD Selection Cross-ruffing 'Best Practices' Workshop," GS0004990 – 5016	2007

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"2007 Performance Reviews," GS0121759 – 76	2007
"2008 Detailed Compensation Communication Guide for HCM," GS0274507 – 31	2008
"2008 Partner and MD Selection: Cross-ruffing Best Practices," GS0004777 – 98	2008
"2008 Performance Reviews," GS0120942 – 66	2008
"2009 MD Selection: Cross-ruffing Best Practices," GS0003547 – 69	2009
"2010 Partner and Managing Director Selection: Cross-Ruffing Best Practices," GS0004705 – 29	2010
"2010 Performance Reviews," GS0120063 – 101	2010
"2010 Performance Reviews," GS0121040 – 74	2010
"2010 Performance Reviews," GS0121427 – 57	2010
"2010 Performance Reviews: Milestones, Overview of Changes and Frequently Asked Questions," GS0004968 – 76	June 2010
"2010 Performance Reviews: Process Changes," GS0004149 – 54	2010
"2011 MD Selection: Cross-Ruffing Best Practices," GS0109235 – 55	2011
"2011 MGMC Investment Banking including Financing Group Compensation Study," GS1043351 – 94	August 2011
"2012 IBD Junior Banker Guidelines - Round 1," GS0378469	2012
"2012 Partner and MD Selection: Cross-Ruffing Best Practices," GS0375517 – 40	2012
"2013 IBD Junior Banker Guidelines - Proposed," GS0378450 – 4	2013
"2013 MD Selection: Cross-Ruffing Best Practices," GS0375294 – 317	2013
"2015 Manager Compensation Communication Guide," GS0375758 – 66	January 2016
"2015 Managing Director Selection Cross-Ruffing Best Practices Guide," GS0375741 – 54	2015
"2015 Performance Reviews: Writing and Delivering Effective Manager Summaries," GS0549598 – 638	September 2015
"2016 Junior Banker Guidelines - USD," GS0378420	2016
"2017 Annual Feedback Summary for Manager(s)," GS0382320 – 38	2017
"2017 Junior Banker Guidelines - USD," GS0378421	2017
"2017 Manager Compensation Communication Guide," GS0375666 – 77	January 2018
"2017 Managing Director Selection Cross-Ruffing Best Practices Guide," GS0375264 – 76	2017
"360-Degree Feedback Report," GS0120025 – 43	2011
"360-Degree Feedback Report," GS0121075 – 94	2011
"360-Degree Feedback Report," GS0375110 – 26	2011
"360-Degree Feedback Report," GS0375127 – 44	2012
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"Equities Individual Review Book," GS0120687 – 709	2008
"Equities Individual Review Book," GS0121556 – 74	2009
"Equities Individual Review Book," GS0121644 – 60	2004
"Feedback360+ Discussion with the Partnership Committee," GS0376157 – 69	February 2017
"Firmwide Review System: Frequently Asked Policy, Data & Reporting Questions," GS0003383 – 91	May 12, 2009
"Fixed Income, Currency and Commodities Individual Review Book," GS0120044 – 62	2004
"Fixed Income, Currency and Commodities Individual Review Book," GS0121383 – 403	2006
"Fixed Income, Currency and Commodities Individual Review Book," GS0121480 – 503	2008
"Fixed Income, Currency and Commodities Individual Review Book," GS0121661 – 83	2007
"Fixed Income, Currency and Commodities Individual Review Book," GS0121722 – 42	2005
"Historical Salary Summary," GS0113480 – 2	March 27, 2012
"IBD Performance Reviews: Changes for 2006," GS0181235 – 45	2006
"IMD 2013 Year End Compensation Calendar," GS0842542	November 2013
"IMD Manager Performance Quartiling: 2015 Overview," GS0380246 – 7	2015
"Investment Banking Division Compensation Guidelines: Compensation Managers," GS0113426 – 39	December 2011
"Investment Banking Division Compensation Guidelines: Compensation Managers," GS0375390 – 404	November 2012
"Investment Banking Division Compensation Guidelines: Compensation Managers," GS0375405 – 20	October 2013
"Investment Banking Division Compensation Guidelines: Compensation Managers," GS0375458 – 74	October 2016
"Investment Banking Division Compensation Guidelines: Compensation Managers," GS0375500 – 15	October 2014
"Investment Banking Division Compensation Guidelines: Compensation Managers," GS0375547 – 63	October 2017
"Investment Banking Division Compensation Guidelines: Compensation Managers," GS0375830 – 45	October 2015
"Investment Banking Individual Review Book," GS0120172 – 94	2008
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"Investment Management Division Compensation Guidelines: Compensation Managers," GS0113911 – 29	December 2011
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"Investment Management Division Compensation Guidelines: Compensation Managers," GS0375632 – 56	October 2014
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"Manager Performance Quartiling," GS0375285 – 93	September 2015
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"Performance Quartiling – Process Overview," GS0113942 – 7	September 30, 2010
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"Performance Quartiling Overview," GS0109443 – 8	October 4, 2011
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"Performance Quartiling Overview," GS0375451 – 7	October 2013
"Performance Review Feedback Report: For De Luis, Mary," GS0375169 – 96	2014
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"Securities Division Compensation Guidelines: Compensation Managers," GS0113896 – 910	December 2011
"Securities Division Compensation Guidelines: Compensation Managers," GS0375324 – 41	October 2016
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"Securities Division Compensation Guidelines: Compensation Managers," GS0375678 – 96	October 2015
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Email from ██████████ to ████████████ et al., "2009 Manager Performance Quartiling: Manager Toolkit and LOA Review Guidelines," and attached documents, GS0109404 – 10	October 1, 2009
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Email from ████████ to ████████████ et al., "Action Required: 2009 Manager Rank Process - Due October 22nd - Reinsurance" with attached document "2009 Quartile File - Reinsurance.xls," GS0113951	October 8, 2009
Email from ████████████ to ██████████ et al., "2009 IBD Quartiling Kickoff - DUE OCTOBER 19th, 5 PM EST" with attached documents "2009 Performance Quartiling Manager Toolkit.pdf" and "Global CRG.xls," GS0113932 – 3	2009
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Email from ██████████ to ████████████ et al., "CRG Non-EMD Quartiling Kickoff - DUE SEPT. 17" with attached document "CRG Non-EMD Quartiling File.xls," GS0113930	September 4, 2008
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FRSDataFile_2005_Winter.accdb (produced February 15, 2013)

FRSDataFile_2006_Summer.accdb (produced February 15, 2013)

FRSDataFile_2006_Winter.accdb (produced March 27, 2013)

FRSDataFile_2007_Summer.accdb (produced February 15, 2013)

FRSDataFile_2007_Winter.accdb (produced February 15, 2013)

FRSDataFile_2008_Summer.accdb (produced February 15, 2013)

FRSDataFile_2008_Winter.accdb (produced February 15, 2013)

FRSDataFile_2009_Summer.accdb (produced February 15, 2013)

FRSDataFile_2009_Winter.accdb (produced February 15, 2013)

FRSDataFile_2010_Summer.accdb (produced February 15, 2013)

FRSDataFile_2010_Winter.accdb (produced February 15, 2013)

FRSDataFile_2011_Summer.accdb (produced February 15, 2013)

FRSDataFile_2011_Winter.accdb (produced February 15, 2013)

Goldman Sachs Production -
Legal_Req_2012_Summer_SENSITIVE_CONFIDENTIAL_DATA.accdb (produced March 30, 2018)

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Document Title   **Document Date**

Goldman Sachs Production -
Legal_Req_2012_Winter_SENSITIVE_CONFIDENTIAL_DATA.accdb (produced
March 30, 2018)

Goldman Sachs Production -
Legal_Req_2013_Summer_SENSITIVE_CONFIDENTIAL_DATA.accdb (produced
March 30, 2018)

Goldman Sachs Production -
Legal_Req_2013_Winter_SENSITIVE_CONFIDENTIAL_DATA.accdb (produced
March 30, 2018)

Goldman Sachs Production -
Legal_Req_2014_Summer_SENSITIVE_CONFIDENTIAL_DATA.accdb (produced
March 30, 2018)

Goldman Sachs Production -
Legal_Req_2014_Winter_SENSITIVE_CONFIDENTIAL_DATA.accdb (produced
March 30, 2018)

Goldman Sachs Production -
Legal_Req_2015_Summer_SENSITIVE_CONFIDENTIAL_DATA.mdb (produced
March 30, 2018)

Goldman Sachs Production -
Legal_Req_2015_Winter_SENSITIVE_CONFIDENTIAL_DATA.accdb (produced
March 30, 2018)

Goldman Sachs Production -
Legal_Req_2016_Summer_SENSITIVE_CONFIDENTIAL_DATA.accdb (produced
March 30, 2018)

Goldman Sachs Production -
Legal_Req_2016_Winter_SENSITIVE_CONFIDENTIAL_DATA.accdb (produced
March 30, 2018)

Goldman Sachs Production -
Legal_Req_2017_Summer_SENSITIVE_CONFIDENTIAL_DATA.accdb (produced
March 30, 2018)

Goldman Sachs Production -
Score_Tables_15S_And_16W_SENSITIVE_CONFIDENTIAL_DATA.accdb (produced
May 3, 2018)

Goldman Sachs Data Production_SENSITIVE_CONFIDENTIAL_DATA FRS 2018
Summer Winter files (produced July 16, 2019)

MD Selection

MDSelectionDataFile_2002_to_2011.accdb (produced February 15, 2013)

Goldman Sachs Production - 2012 EMD Candidate
List_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 29, 2018)

Goldman Sachs Production - 2013 EMD Candidate
List_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 29, 2018)

Goldman Sachs Production - 2015 EMD Candidate
List_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 29, 2018)

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Document Title	Document Date

Goldman Sachs Production - 2017 EMD Candidate List_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 29, 2018)

IBD

IBD Analysis 2002 to 2011 (SENSITIVE CONFIDENTIAL DATA).xlsx (produced October 9, 2013)

GS IBD Productivity Metrics (Sensitive Confidential Data).xlsx (produced March 1, 2013)

IBD Banker Quartile and Education (SENSITIVE CONFIDENTIAL DATA).xlsx (produced October 9, 2013)

Goldman Sachs Production - 2012 - 2017 IBD Production_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 20, 2018)

Goldman Sachs Production - UAT_2012_BUL_Banker_Profile_Summary_SENSITIVE_CONFIDENTIAL_DATA.xls (produced March 20, 2018)

Goldman Sachs Production - UAT_2013_BUL_Banker_Profile_Summary_SENSITIVE_CONFIDENTIAL_DATA.xls (produced March 20, 2018)

Goldman Sachs Production - UAT_2014_BUL_Banker_Profile_Summary_SENSITIVE_CONFIDENTIAL_DATA.xls (produced March 20, 2018)

Goldman Sachs Production - UAT_2015_BUL_Banker_Profile_Summary_SENSITIVE_CONFIDENTIAL_DATA.xls (produced March 20, 2018)

Goldman Sachs Production - UAT_2016_BUL_Banker_Profile_Summary_SENSITIVE_CONFIDENTIAL_DATA.xls (produced March 20, 2018)

Goldman Sachs Production - UAT_2017_BUL_Banker_Profile_Summary_SENSITIVE_CONFIDENTIAL_DATA.xls (produced March 20, 2018)

Goldman Sachs Production - 2018 Year End Compensation Process IBD_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced April 29, 2019)

Goldman Sachs Production - BUL_Banker_Profile_Summary 2018 (ASSC-VP)_SENSITIVE_CONFIDENTIAL_DATA.xls (produced April 29, 2019)

IMD

GS IMD ICE Metrics (Sensitive Confidential Data).xlsm (produced February 21, 2013)

GS PWM Gross Credits, 2009-2011 (Sensitive Confidential Data).xlsx (produced July 29, 2013)

GS IMD Metrics (Sensitive Confidential Data).xlsm (produced February 21, 2013)

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Document Title	Document Date

Goldman Sachs - IMD Production Data___SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 22, 2018)

Goldman Sachs - For 2018 - IMD Production Data___SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced April 29, 2019)

FY 2018 BU Metrics_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced July 16, 2019)

Securities

2005 Securities Final Comp Download (SENSITIVE CONFIDENTIAL DATA).xlsx (produced September 24, 2013)

2006 Securities Final Comp Download (SENSITIVE CONFIDENTIAL DATA).xlsx (produced September 24, 2013)

2007 Securities Final Comp Download (SENSITIVE CONFIDENTIAL DATA).xls (produced September 24, 2013)

2008 Securities Final Comp Download (SENSITIVE CONFIDENTIAL DATA).xls (produced September 24, 2013)

2009 Securities Final Comp Download (SENSITIVE CONFIDENTIAL DATA).xlsx (produced September 24, 2013)

2010 Securities Final Comp Download (SENSITIVE CONFIDENTIAL DATA).xlsx (produced September 24, 2013)

2011 Securities Final Comp Download (SENSITIVE CONFIDENTIAL DATA).xlsx (produced September 24, 2013)

GS Securities Division Production (Sensitive Confidential Data).XLSX (produced February 21, 2013)

GSOE_OrgChart_Equities_Division_20081028_070140 (Sensitive Confidential Data).xls (produced June 11, 2013)

GSOE_OrgChart_Equities_Division_20091124_070123 (Sensitive Confidential Data).xls (produced June 11, 2013)

GSOE_OrgChart_Equities_Division_20101130_070137 (Sensitive Confidential Data).xls (produced June 11, 2013)

GSOE_OrgChart_Equities_Division_20111129_070128 (Sensitive Confidential Data).xls (produced June 11, 2013)

GSOE_OrgChart_FICC_Division_20081028_070241 (Sensitive Confidential Data).xls (produced June 11, 2013)

GSOE_OrgChart_FICC_Division_20091124_070229 (Sensitive Confidential Data).xls (produced June 11, 2013)

GSOE_OrgChart_FICC_Division_20101130_070310 (Sensitive Confidential Data).xls (produced June 11, 2013)

GSOE_OrgChart_FICC_Division_20111129_070234 (Sensitive Confidential Data).xls (produced June 11, 2013)

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Document Title	Document Date

Americas 2012 Final Comp Download_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 9, 2018)

Americas 2013 Final Comp Download_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 9, 2018)

Americas 2014 Final Comp Download_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 9, 2018)

Americas 2015 Final Comp Download_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 9, 2018)

Americas 2016 Final Comp Download_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 9, 2018)

Americas 2017 Final Comp Download_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced March 9, 2018)

2018 Final Comp Download_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced April 29, 2019)

Prior Pay

2004 Merged OpCom Report_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

2005 merged Op Com Sheet_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

2006 IMD Offers_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

2006 Merged OpCom Report _SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

2007 Merged OpCom Report _SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

2008 Merged OpCom Report_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

2009 IMD Offers_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

2009 Merged Opcom Report Updated with Early 2010 Reports_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

2010 IMD Offers_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

2010 Merged OpCom Report_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

2011 IMD Offers_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

2011 Merged OpCom Report (incl. hires on 2010 reports and jan 4 report)_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

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Document Title	Document Date

2012 Merged OpCom Report_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

Gender Class Pre GS Offer Data_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

Historic Americas VP Hires_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

Other

GS CCO - Summary of EMD PATC - 20180913.xlsx (produced September 13, 2018)

2012-2018 aa_job_SENSITIVE_CONFIDENTIAL_DATA.xlsx (produced August 29, 2019)

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11. APPENDIX C – VARIABLES AND SAMPLES USED IN SHAW REGRESSION MODELS

Variable Name	Variable Description	Farber Regressions [1]	Shaw Regression Model Compensation	Manager Quartile	360 Score [2]	Promotions [3]
Compensation Variable						
lnpay	The natural log of per-annum total compensation or PATC (USD) from the CRS data. This is full-time annualized total compensation for the year.[4] When PATC is missing, the proposed PATC from the Securities compensation files is used instead.	Dependent variable	Dependent variable			
Gender Variable						
female	Indicator for whether the person identified their gender as "Female."	√	√	√	√	√
Base Controls						
reg_year	Fiscal year: 2005 to 2018	√	√	√	√	√
office_reg	The city the professional's office is located. Smaller offices with fewer than 100 observations are grouped into "Other" category. (In Promotion Regressions, offices with fewer than 40 observations are grouped together.)	√	√	√	√	√
related_exp	Number of years of prior experience for professionals. Relevant experience is defined by meeting any of the following conditions: priorindustry is "Finance," or priorworktype is any of the following "Accounting Firms," "Commercial Banks," "Credit Unions," "Federal Reserve Banks/board," "Insurance/financial Services," "Investment/Merchant/banks/brok," or "Savings & Loans/Mortgage Inst." This variable enters the regressions linearly and quadratically.	√				
gstenure	The amount of time a professional has been in current Goldman Sachs hire stint. This variable enters the regressions linearly and quadratically.	√	√	√	√	√
reg_title_stinttime	For Investment Management and Securities, this is the amount of time a professional has been in a title during current Goldman Sachs hire stint. For Investment Banking Junior Bankers, this is the sum of the amount time as an Associate and the amount of time as a Vice President during current Goldman Sachs hire stint. For Investment Banking Senior Bankers, this is the amount time as a Vice President. This variable enters the regressions linearly and quadratically.		√	√	√	√
Variable Name	**Variable Description**					

REDACTED VERSION

		Farber Regressions [1]	Compensation	Manager Quartile	360 Score [2]	Promotions [3]
reg_yrs_ibd	An integer representing the class of Investment Banking Junior Bankers (e.g., 2nd year Junior Banker).		√	√	√	
lat	An indicator for lateral hire. A laterally hired Vice President is someone who was hired directly into their position as Vice President, as opposed to promoted from Associate (their most recent hire date (hired or rehired) is the same as their Vice President Date.) A laterally hired Associate is someone who was hired directly into their position as Associate, as opposed to promoted from Analyst, , and who is not flagged as a "Campus Hire" (i.e., to be classified as a lateral, the Associate's most recent hire date is the same as their Associate Date, and the hire was an "Experienced Hire.") A laterally hired Investment Banking Junior Banker is someone who is a lateral Associate or a lateral Vice President as a Junior Banker. A laterally hired Investment Banking Senior Banker is someone who is hired as a lateral Vice President.	√	√	√	√	√
new_lat	Indicator for the first year when the professionals are lateral hires.	√	√	√	√	
hed	A categorical variable for the "highest education." The highest education definition adheres to the following hierarchy: "High School, no degree" < "High School" < "Some College" < "Associate's degree" < "Bachelor's degree" < "Master's degree" < "Professional degree" < "Doctorate degree." "Missing" is included as separate category.	√	√	√	√	
hed_promotion	A categorical variable for the "highest education." The highest education definition adheres to the following hierarchy: "High School, no degree" < "High School" < "Some College" < "Associate's degree" < "Bachelor's degree" < "Master's degree" < "Professional degree" < "Doctorate degree." "Missing" is included as separate category. "Some College," "Associate's degree," and "Bachelor's degree" are grouped together.	√				√
jobgroup_full	Affirmative Action job group. AA job groups with fewer than 150 observations are grouped into single "other" AA job group category. (In Prof. Farber's promotion regressions, job groups with fewer than 250 observations are grouped together.)	√				
division	The division of the professional.	√	Model run by division	Model run by division	Model run by division	Model run by division

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Variable Name	Variable Description	Farber Regressions [1]	Compensation	Manager Quartile	360 Score [2]	Promotions [3]
Business Unit Variables						
bu	Captures the Business Unit level where the compensation budget is set. Business Unit definition follows the declarations of divisional leaders and is created using the relevant divisional files and Level 6 – Level 8 values from PeopleSoft. Similar business unit names across years are standardized. Additionally for IBD: if a professional's PeopleSoft Level 8 appears among the Business Unit values in that year for other IBD professionals, the PeopleSoft Level 8 value is assigned as that professional's Business Unit. For professionals still missing Business Unit, I use a one-to-one mapping between IBD Business Unit and PeopleSoft Level 8 variable for each year to assign Business Unit based on the PeopleSoft Level 8 variable. The variable has 211 categories including "Natural Resources," "Industrial," "Healthcare," a "Missing" category, etc.	√ (only "Model 3")	√	Included in BU analyses	Included in BU analyses	√
bu_year	An interaction between the Business Unit and the fiscal year.		√			
Function Variables						
reg_function	For Investment Management: Investment Management function captures the different types of roles within the Investment Management division. The same function can exist across Business Units. Investment Management function consists of 78 categories including "Advisory," "Global Management," "Lending," a "missing" category, etc. Similar or identical Investment Management functions that exist in Securities are treated as separate functions. For Securities: Securities function captures different types of roles within the Securities division. The same function can exist across Business Units. Securities function consists of 11 categories including "trading," "sales," "strats" category, etc. Similar or identical Securities functions that exist in Investment Management are treated as separate functions. No function variable is available for the Investment Banking Division.		√			√

REDACTED VERSION

Variable Name	Variable Description	Farber Regressions [1]	Compensation	Manager Quartile	360 Score [2]	Promotions [3]
Investment Banking Production Variables						
l140_ibd – l144_ibd	A set of indicators for professionals' Investment Banking annualized production quartile (including a missing indicator). Production is measured as total revenue from all projects within a given year and title (JR or SR Banker) for Investment Banking professionals. This data is available for Junior Bankers before 2012 and Senior Bankers for the full period.		√	√	√	√
lag_l140_ibd - lag_l144_ibd	A set of indicators for previous years' Investment Banking production quartile (including a missing indicator).		√	√	√	√
reg_rep	An indicator for Investment Banking Senior Bankers set to one if the professional holds a client representative role.		√	√	√	√
l240_ibd – l244_ibd	A set of indicators for professionals' Investment Banking annualized production quartile (including a missing indicator). Production is measured as the revenue from projects for which the professional is the client representative within a given year for Investment Banking Senior Bankers. This data is only available before 2012.		√	√	√	√
lag_l240_ibd - lag_l244_ibd	A set of indicators for previous years' production measure quartile from projects which the Investment Banking Senior Banker is the client representative (including a missing indicator).		√	√	√	√
Investment Management Production Variables						
prodgsam_comp_score	Investment Management Vice President production measured by Investment Composite Score, taking a continuous value from 0 to 1. This variable enters the regressions linearly and quadratically.		√	√	√	√
noprodgsam_comp_score	An indicator for missing Investment Management Vice President Investment Composite Score.		√	√	√	√
quart_ltfb_full_yr	A set of indicators for professionals' Investment Management Vice President annualized production quartile (including a missing indicator). Production is measured as the gross sales of "Long Term Fee Based" products from Investment Management Profiles. This data is only available in 2011 and onward.		√	√	√	√
lag_quart_ltfb_full_yr	A set of indicators for previous years' Investment Management production quartile (including a missing indicator).		√	√	√	√

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Variable Name	Variable Description	Farber Regressions [1]	Compensation	Manager Quartile	360 Score [2]	Promotions [3]
Securities Production Variables						
l140_sec – l144_sec	A set of indicators for professional's Securities annualized production quartile (including a missing indicator). Production is measured by the actual financial contribution of the professional within a given year, division (FICC or Equities), title (Associate or Vice President) for Securities professionals. Contributions are defined differently for professionals with different functions. For example, traders production refers to their profits and loss; salespeople production refers to sales credits. This data is available in 2005 and onward.		√	√	√	√
lag_l140_sec – lag_l144_sec	A set of indicators for previous years' securities production measure quartile (including a missing indicator).		√	√	√	√
Manager Quartile Variables						
top_quartile	An indicator for whether the Manager quartile is "1."	Dependent variable	√	Dependent variable		
quartile	Manager quartile taking values: "0," "1," "23," "45." "0" indicates missing. "1," "2," and "3" indicate the professional has been placed in the top 25th, 26th–50th, or 51st–75th percentile of all professionals, respectively. Prior to 2016, "5" represented the bottom 10% and "4" represented the next 15%. Since 2016, there was no "5" and so "4" represented the bottom 25%. "4" and "5" are grouped into "45" and "2" and "3" are grouped into "23."	Used in damages model				√
360 Score Variables						
avgscoreRP_S	An average FRS score over 9 categories adjusted for the relative harshness/leniency of reviewers from 2003 to 2015. Takes a continuous value rounded to the hundredth from 0 to 5 during 2003 to 2009 and from 0 to 9 during 2010 to 2015. FRS score is interacted with time periods for each review regime.	Dependent Variable; Used in damages model	√	√	Dependent variable	√
out_omr	An indicator for whether the Overall Manager Rating in 2016–2018 is "Outstanding."	Dependent Variable	√			
Ogni	A categorical variable indicating whether the professionals receive Overall Manager Rating of "Good," "Need Improvement," or "Outstanding" in 2016–2018, interacted with time periods for each review regime.	Used in damages model				√

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Variable Name	Variable Description	Farber Regressions [1]	Compensation	Manager Quartile	360 Score [2]	Promotions [3]
Other Variables						
guarantee	An indicator for whether the professional is guaranteed compensation.		√			
sec_covered	A categorical variable indicating whether the professionals are covered by regulatory guidance related to providing financial incentives for professionals "whose business activities may expose the firm to a material level of risk" for 2005–2018. It takes a value: "N," "Y," "missing."		√			√
div_transfer_flag	An indicator for whether the professional transferred into the division within the fiscal year.		√			√
Promotion Variables						
md_promo_rd	An indicator for whether the professional is promoted at the end of the fiscal year to EMD.	Dependent variable				Dependent variable
md_candidate	Whether a Senior Banker or Vice President is nominated for cross-ruffing.					Dependent variable

Note:

[1] Specification of Professor Farber's Model 2a is included unless noted otherwise. Professor Farber used "Total Cost for Equity Calculated Amount" converted to an annualized basis as the compensation variable for years prior to 2012.

[2] 360 score regressions are run separately by review regime: 2005–2010 and 2010–2015.

[3] Promotions regressions are run on Vice Presidents in Securities and IMD, and on Senior Bankers in IBD.

[4] Deposition of Stephanie Blinder, April 30, 2013, p. 153, 7–10.

333. **Baseline Regression Sample.** Unless noted in an exhibit, the regression sample consists of Associates and Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, had non-missing manager quartile, had non-missing 360 review score / OMR, and were not self-sustaining Private Wealth Advisors.

334. I start my analyses in 2005 for each division due to systematic missing data in earlier years. In IMD and IBD, data on 360 scores is missing for almost all professionals in 2003 and 2004. While Prof. Farber technically starts his analysis in 2003 for both of these divisions, the missing data in those years means that he includes a minimal number of professionals from those years in his analysis sample.[339] In Securities, production data is unavailable until 2005.

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[339] Prof. Farber does include professionals with missing 360 review scores or manager quartiles in one of his compensation analyses. However, he does not include them in his regression sample when assessing the effect of the challenged processes on compensation, or when estimating purported back-pay damages and one-time pay parity adjustment. See Farber Report, Tables 3–4, 15–16, 25–26, and 27.

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Given the importance of production in any model of the challenged processes or compensation setting (as discussed extensively above), I start my analysis in 2005.

335. **AA job codes.** I exclude AA job codes from my models because they are poor, highly-aggregated measures of "job" that do not add additional information on top of finer variables like Business Unit and function.[340]

336. **Related prior experience**. In each of his models, Prof. Farber includes a variable he describes as "related prior experience" (and the square of that variable), which he created based on PeopleSoft data production recording information on some professionals' prior work type. Prof. Farber codes prior work type as relevant if (a) the prior industry is "Finance," or (b) prior work type is any of the following "Accounting Firms," "Commercial Banks," "Credit Unions," "Federal Reserve Banks/board," "Insurance/financial Services," "Investment/Merchant/banks/brok," or "Savings & Loans/Mortgage Inst." Prof. Farber indicates that Defendant's expert Dr. Michael Ward (who submitted expert reports during class certification) created this variable, though it appears Dr. Ward never used it in any analyses.

337. After reviewing how Prof. Farber constructed the variable, I find that the experience variable is flawed, inconsistently constructed, and too subjective and ad-hoc to be informative. As result, I excluded it from my baseline analyses.

338. First, Prof. Farber provides no explanation for which types of prior work he flags as relevant and why. Without any such explanation, his particular selections are arbitrary, and render the variable uninformative. Second, he attempts to remove certain stints of experience he deems irrelevant, but does so in a very ad-hoc and inconsistent way, e.g., he attempts to exclude internships, but he fails to exclude many stints that are recorded as summer and work-study positions. Third, he lumps together many types of (arbitrarily selected) prior experience in a way that makes it hard to understand what his variable actually captures. For example, using his data processing choices, an IBD associate who worked 3 years as a software engineer prior to starting at GS has the same "related prior experience" as someone who worked in IBD for 3 years at Bank of America.

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[340] See ¶ 73 for additional discussion of AA job codes.

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12. APPENDIX D – NUMBER OF DECISION MAKERS IN THE 360 REVIEW PROCESS BY YEAR

Exhibit 46

There are many individual decision makers in the 360 review process for class members: Number of 360 reviewers for class members by division, corporate title, and year

Year	Number of 360 Reviewers for Associates / Junior Bankers		
	Investment Banking	Investment Management	Securities
2005	694	496	1,449
2006	810	445	1,567
2007	744	563	1,656
2008	639	433	1,378
2009	611	486	1,061
2010	658	687	894
2011	729	810	751
2012	665	676	679
2013	693	552	595
2014	649	693	656
2015	772	720	563
2016	733	495	399
2017	689	651	541
2018	729	592	598

Year	Number of 360 Reviewers for Vice Presidents / Senior Bankers		
	Investment Banking	Investment Management	Securities
2005	334	918	1,683
2006	336	988	1,693
2007	377	990	1,835
2008	186	1,012	1,776
2009	226	1,115	1,360
2010	228	1,156	1,331
2011	309	1,154	1,288
2012	392	1,182	1,153
2013	391	1,437	1,059
2014	407	1,544	1,069
2015	439	1,658	1,003
2016	216	1,342	565
2017	309	1,683	835
2018	291	1,747	787

Source: Goldman Sachs Data Production

Note: The sample consists of reviewers of Associate and Vice President class members who are in the relevant divisions as of the end of the fiscal year. Individual reviewers may appear in multiple counts if they review professionals across professional corporate job titles or across divisions.

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13. APPENDIX E – GENDER GAPS IN 360 REVIEW SCORES BY BUSINESS UNIT

Exhibit 47

Estimated 360 review score gap by Business Unit: Investment Banking, Junior Bankers

Business Unit	Female-Male 360 Score Difference		Number of Person-Year Observations
TMT	-0.10		389
Financial Institutions	-0.12	*	343
Natural Resources	-0.16	*	318
Industrial	-0.04		268
Public Sector & Infrastructure	-0.03		249
Leveraged Finance	-0.02		246
Healthcare	-0.02		230
Consumer Retail Group	-0.09		229
Equity Capital Markets	-0.07		136
Real Estate	-0.05		119
Structured Finance	-0.14		109
FG Financial Institutions Grp	-0.07		108
West Region Advisory	0.01		83
Investment Grade	-0.04		76
RE Financing	-0.03		75
Equity Derivatives	-0.10		57
FICC Derivatives	-0.25		43
Corporate Finance Solutions	-0.05		41
Management	-0.48	*	30
M&A Group	-0.30		29
Financial Sponsors / LBO Grp.	0.13		27
Emerging Markets	-0.18	*	24
Leadership	-0.02		19
Investment Banking Services	0.23		16
IBD Strats	0.28		12
IBD Management & Strategy	-0.30		11
Corporate & PSI Derivatives	-0.36		10
Regional Leadership	0.22		9
Commodity Finance	-0.15		7
Pensions	-0.11		7
Latin America	-0.02		7
Clean Tech & Renewables Group	-0.47	*	3

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Gender Gap:	16.9%
Insignificant Negative Gender Gap:	78.9%
Insignificant Positive Gender Gap:	4.2%
Significant Positive Gender Gap:	0.0%

REDACTED VERSION

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male 360 Score Difference are displayed. The regression specification controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male 360 Score Difference refers to the difference between male and female 360 scores implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated Female-Male 360 Score Difference indicates statistical significance at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

Exhibit 48

Estimated 360 review score gap by Business Unit: Investment Banking, Senior Bankers

Business Unit	Female-Male 360 Score Difference		Number of Person-Year Observations
Public Sector & Infrastructure	-0.03		287
TMT	-0.03		152
Natural Resources	-0.23	*	122
Financial Institutions	0.02		119
Industrial	-0.05		106
Investment Grade	-0.16	*	100
Leveraged Finance	-0.09	*	100
Healthcare	-0.11		95
Consumer Retail Group	-0.19	*	90
Structured Finance	0.06		80
Equity Capital Markets	-0.09		58
FG Financial Institutions Grp	-0.05		54
RE Financing	0.16		49
Real Estate	-0.18	*	48
FICC Derivatives	-0.04		37
Financial Sponsors / LBO Grp.	0.36	*	27
M&A Group	-0.28	*	26
Investment Banking Services	-0.06		24
Corporate Finance Solutions	-0.15		21
Equity Derivatives	-0.29	*	18
Management	0.17	*	17
Corporate & PSI Derivatives	0.11		8
IBD Strats	0.49	*	6
Pensions	-0.18	*	4
Clean Tech & Renewables Group	-0.34	*	2
Conflicts	0.14	*	2

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Gender Gap:	27.0%
Insignificant Negative Gender Gap:	56.8%
Insignificant Positive Gender Gap:	14.8%
Significant Positive Gender Gap:	1.4%

REDACTED VERSION

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male 360 Score Difference are displayed. The regression specification controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male 360 Score Difference refers to the difference between male and female 360 scores implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated Female-Male 360 Score Difference indicates statistical significance at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 49

Estimated 360 review score gap by Business Unit: Investment Management, Associates

Business Unit	Female-Male 360 Score Difference		Number of Person-Year Observations
PWM US	0.00		591
PWM	-0.02		287
Americas Third Party	-0.13	*	230
AIMS	0.02		212
QIS	-0.05		109
Fixed Income	0.14	*	102
Americas Institutional	-0.01		85
Fundamental Equity	0.09		73
IMD Strats	0.20	*	67
Global Portfolio Solutions	-0.06		33
Division Management	-0.19		32
Market Solutions Group	0.03		30
GSIP	-0.28		28
Fixed Income + LH	0.16		28
Global ISG	-0.15		26
PWM LatAm	0.40	*	16
Capital Markets	-0.27		12
GSAM Credit Alternatives	-0.33		9
US ACM	0.52	*	9
Wealth Advisory Services	-0.19		8
Reinsurance	0.11	*	7
MSG - SP	0.33	*	7
Quantitative Equity	-0.32		6
PCG	-0.36	*	4
Alternative Capital Markets	-0.12	*	4
Insurance	-0.11		4
MSG - GOAS	0.25	*	4
US MCG	-0.11		3
REIT	0.06	*	3
Global PWM	0.71	*	3

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Gender Gap:	12.4%
Insignificant Negative Gender Gap:	26.9%
Insignificant Positive Gender Gap:	52.4%
Significant Positive Gender Gap:	8.3%

REDACTED VERSION

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male 360 Score Difference are displayed. The regression specification controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male 360 Score Difference refers to the difference between male and female 360 scores implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated Female-Male 360 Score Difference indicates statistical significance at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 50

Estimated 360 review score gap by Business Unit: Investment Management, Vice Presidents

Business Unit	Female-Male 360 Score Difference		Number of Person-Year Observations
Americas Third Party	-0.05		1,096
PWM US	-0.02		597
Fixed Income	-0.03		472
AIMS	-0.05		406
Fundamental Equity	0.01		337
Americas Institutional	0.08	*	283
QIS	0.01		211
PWM	0.02		199
IMD Strats	0.04		151
Fixed Income + LH	0.00		107
Market Solutions Group	0.03		90
GSIP	-0.03		88
Global ISG	0.12		73
Global Portfolio Solutions	-0.12		67
Division Management	-0.05		66
Wealth Advisory Services	-0.09		62
Capital Markets	-0.01		61
GSAM Credit Alternatives	0.02		51
Insurance	-0.10	*	31
Money Markets	-0.03		28
Strategic Client Services	-0.15	*	19
MSG - Central Muni	-0.15		16
Global PWM	0.04		15
REIT	-0.02		14
MSG - SP	0.08		14
US MCG	-0.21		12
MSG - GOAS	0.04		12
US ACM	0.13	*	10
PWM LatAm	-0.32		9
PCG	-0.03		8
Reinsurance	0.06		8
Alternative Capital Markets	0.09		7
Communications & Marketing	0.14	*	6
Real Estate Investment Group	0.29	*	4
US GSAM Distribution	-1.41	*	3

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Gender Gap:	0.9%
Insignificant Negative Gender Gap:	70.2%
Insignificant Positive Gender Gap:	19.8%
Significant Positive Gender Gap:	9.1%

REDACTED VERSION

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male 360 Score Difference are displayed. The regression specification controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male 360 Score Difference refers to the difference between male and female 360 scores implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated Female-Male 360 Score Difference indicates statistical significance at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 51

Estimated 360 review score gap by Business Unit: Securities, Associates

Business Unit	Female-Male 360 Score Difference		Number of Person-Year Observations
FICC Americas Sales	-0.07	*	491
Prime Brokerage	-0.02		392
FICC Strats	-0.10		345
NYSE Specialists	-0.07		256
Americas Sales	-0.09	*	216
EQ Americas Execution Services	-0.05		203
Mortgages	-0.02		201
Clearing	-0.11	*	192
Equities Strategies	-0.02		175
Credit Trading	-0.09		160
AmSSG	-0.06		120
Americas Trading	-0.05		105
Prime Services	0.01		89
Commodities	-0.04		82
Equities Strats	-0.04		77
Global Interest Rate Products	0.08		59
Credit Principal Investing	-0.01		49
Securities Services	-0.06		46
ETF Specialists	-0.23	*	45
GSSG	0.05		41
EM Trading LatAM	-0.29	*	39
Commodities ex-GCPI	0.15	*	39
GSPS	-0.11		37
GSET/Futures	0.04		37
EQ Global Sales	-0.02		35
Global Credit Trading	-0.12		34
Currency Trading	-0.12		32
FICC Franchise Strats	-0.04		27
Americas Derivatives Trading	0.00		26
IRP ex Agency JV	0.04		26
QT	0.14	*	25
Global EQ Sales/Execution	0.03		24
EQ Americas Sales	0.12		22
Reinsurance Group	-0.10		20
EQ Global Derivatives Trading	-0.01		20
GSET	-0.35	*	19
Special Assets Group	-0.30	*	19
Mortgages Trading (ex JV)	-0.29	*	19
Equities Strats (ex QT)	0.08		17
EQ Global One Delta Trading	-0.20	*	16
Global Credit	-0.03		16
Money Markets	0.19		16
EQ Franchise Strats	-0.40		15
Americas One Delta Trading	-0.30	*	14
IBD Strats	0.07		12
Quantitative Trading	-0.48	*	11
IRP Mortgages Agencies JV	-0.34	*	11
Commodities Trading ex-GCPI	0.12	*	11

REDACTED VERSION

Business Unit	Score	Sig	Count
EQ Global Electronic Execution Services and Exec Strats	-0.10		10
Principal Strategic Investments	-0.04		10
Commodities Trading	-0.02		10
Futures	0.07		9
EQ Global Execution Services	0.20		9
Core / Divisional Strats	0.15		7
EQ Global Execution Services ex-Electronic	-0.17	*	6
EQ Sales Strats	-0.11	*	6
EQ Desk Strats	0.00		6
Commodities Sales Americas	-0.28	*	5
FICC Sales Strats	0.03		5
Global Liquidity Products	-0.07		4
GLP/Risk	0.34	*	3
Credit Research	0.64	*	3
Securities Business Management	-0.32	*	2
FICC Japan Sales	0.41	*	2
GS Bank	0.50	*	2

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Gender Gap:	35.1%
Insignificant Negative Gender Gap:	53.8%
Insignificant Positive Gender Gap:	9.7%
Significant Positive Gender Gap:	1.3%

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male 360 Score Difference are displayed. The regression specification controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male 360 Score Difference refers to the difference between male and female 360 scores implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated Female-Male 360 Score Difference indicates statistical significance at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 52

Estimated 360 review score gap by Business Unit: Securities, Vice Presidents

Business Unit	Female-Male 360 Score Difference		Number of Person-Year Observations
FICC Americas Sales	-0.03		1,248
Prime Brokerage	-0.01		810
FICC Strats	-0.06		731
Americas Sales	-0.06		565
EQ Americas Execution Services	-0.08		543
Prime Services	-0.01		469
Equities Strategies	-0.10	*	327
Americas Trading	-0.02		294
Credit Trading	-0.05		281
Mortgages	-0.12	*	275
Clearing	0.00		272
Equities Strats	-0.13		260
NYSE Specialists	-0.19		193
AmSSG	-0.23	*	175
Commodities	-0.12	*	165
GSET/Futures	0.05		136
Americas One Delta Trading	-0.10		122
Global Interest Rate Products	0.01		122
Global EQ Sales/Execution	-0.05		118
EQ Global Sales	-0.05		115
EQ Franchise Strats	0.00		115
GSSG	-0.22	*	111
Currency Trading	-0.08	*	99
QT	-0.23		91
Commodities ex-GCPI	-0.13		88
FICC Franchise Strats	0.07		86
EM Trading LatAM	-0.15	*	78
GSET	0.03		76
EQ Global One Delta Trading	0.16	*	72
Global Credit Trading	0.00		69
Equities Strats (ex QT)	-0.06		67
Americas Derivatives Trading	0.04		67
EQ Americas Sales	0.01		66
Money Markets	-0.26	*	65
Credit Principal Investing	0.00		64
QT Strats	-0.27	*	63
EQ Global Electronic Execution Services and Exec Strats	0.05		61
IRP ex Agency JV	0.03		57
GSPS	-0.10		48
EQ Global Derivatives Trading	-0.06		48
EQ Global Execution Services	0.03		48
Futures	0.10		47
Securities Services	0.03		46
Reinsurance Group	-0.09		45
Quantitative Trading	-0.06		43
Core / Divisional Strats	-0.15		38
Special Assets Group	-0.37	*	34

REDACTED VERSION

Business Unit	Female-Male 360 Score Difference		Observations
Global Credit	-0.06		34
Mortgages Trading (ex JV)	-0.03		34
Principal Strategic Investments	-0.12		31
FICC Desk Strats	0.00		31
FICC Electronic Trading/Exec Strats	-0.18		29
EQ Global Execution Services ex-Electronic	0.06	*	29
Short-Term Interest Rates	-0.18	*	27
SLG	-0.24	*	25
EQ Desk Strats	-0.18		25
FICC Sales Strats	0.03		22
Commodities Sales Americas	0.07		18
NYSE Specialists and Strats	-0.37	*	17
EQ Global Emm Trading and Strats	-0.29	*	17
IRP Mortgages Agencies JV	-0.26	*	15
QT/Specialists and Strats	-0.05		15
EQ Sales Strats	0.07		14
Commodities Trading	-0.10	*	12
GLP/Risk	0.20		9
Securities Business Management	0.12	*	7
Credit Research	0.02		6
Principal Investing Desk Strats	0.22		6
Principal Strategic Investment Group	-0.02		3

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Gender Gap:	11.4%
Insignificant Negative Gender Gap:	79.2%
Insignificant Positive Gender Gap:	9.0%
Significant Positive Gender Gap:	0.5%

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male 360 Score Difference are displayed. The regression specification controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male 360 Score Difference refers to the difference between male and female 360 scores implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated Female-Male 360 Score Difference indicates statistical significance at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

14. APPENDIX F – GENDER GAPS IN MANAGER QUARTILING BY BUSINESS UNIT

Exhibit 53

Estimated manager quartiling gap by Business Unit: Investment Banking, Junior Bankers

Business Unit	Average Marginal Effect of Gender on Top Manager Quartile Placement	Number of Person-Year Observations
TMT	0.02%	389
Financial Institutions	0.03%	343
Natural Resources	-0.11% *	318
Industrial	-0.04%	268
Public Sector & Infrastructure	0.04%	249
Leveraged Finance	-0.03%	246
Healthcare	-0.01%	230
Consumer Retail Group	-0.10%	229
Equity Capital Markets	0.01%	136
Real Estate	-0.09%	119
Structured Finance	0.05%	109
FG Financial Institutions Grp	-0.09%	108
West Region Advisory	0.18%	83
Investment Grade	0.15%	76
RE Financing	0.05%	75
Equity Derivatives	0.21% *	57
FICC Derivatives	0.13%	43
M&A Group	-0.21% *	29
Financial Sponsors / LBO Grp.	0.14%	27
Emerging Markets	-0.05%	24
Leadership	-0.22%	19
Investment Banking Services	0.04%	16

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Marginal Effect:	9.9%
Insignificant Negative Marginal Effect:	35.7%
Insignificant Positive Marginal Effect:	52.4%
Significant Positive Marginal Effect:	2.0%

Source: Goldman Sachs Data Production

Note: Average Marginal Effect of Gender on Top Manager Quartile Placement refers to the average marginal effect of being female relative to males, for females, on the probability of being placed in the top manager quartile. Only Business Units with both male and female professionals and an estimable average marginal effect are displayed. The regression controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, 360 review score, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. "*" after average marginal effects indicates statistical significance of the marginal effect of gender at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 54

Estimated manager quartiling gap by Business Unit: Investment Banking, Senior Bankers

Business Unit	Average Marginal Effect of Gender on Top Manager Quartile Placement	Number of Person-Year Observations
Public Sector & Infrastructure	-0.09%	287
TMT	-0.04%	152
Natural Resources	-0.05%	122
Financial Institutions	0.23%	119
Industrial	-0.17%	106
Leveraged Finance	-0.18% *	100
Investment Grade	-0.01%	100
Healthcare	0.12%	95
Consumer Retail Group	0.05%	90
Structured Finance	-0.02%	80
Equity Capital Markets	-0.07%	58
FG Financial Institutions Grp	0.05%	54
RE Financing	-0.11%	49
FICC Derivatives	-0.46% *	37

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Marginal Effect:	7.7%
Insignificant Negative Marginal Effect:	72.6%
Insignificant Positive Marginal Effect:	19.7%
Significant Positive Marginal Effect:	0.0%

Source: Goldman Sachs Data Production

Note: Average Marginal Effect of Gender on Top Manager Quartile Placement refers to the average marginal effect of being female relative to males, for females, on the probability of being placed in the top manager quartile. Only Business Units with both male and female professionals and an estimable average marginal effect are displayed. The regression controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, 360 review score, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. "*" after average marginal effects indicates statistical significance of the marginal effect of gender at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 55

Estimated manager quartiling gap by Business Unit: Investment Management, Associates

Business Unit	Average Marginal Effect of Gender on Top Manager Quartile Placement	Number of Person-Year Observations
PWM US	-0.06%	591
PWM	-0.02%	287
Americas Third Party	0.10%	230
AIMS	0.03%	212
QIS	0.01%	109
Fixed Income	0.06%	102
Americas Institutional	0.16%	85
Fundamental Equity	-0.04%	73
IMD Strats	0.11%	67
Global Portfolio Solutions	0.00%	33
Market Solutions Group	0.03%	30
Fixed Income + LH	0.08%	28
Global ISG	-0.30% *	26
Capital Markets	0.12%	12
Wealth Advisory Services	0.22%	8

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Marginal Effect:	1.5%
Insignificant Negative Marginal Effect:	53.7%
Insignificant Positive Marginal Effect:	44.8%
Significant Positive Marginal Effect:	0.0%

Source: Goldman Sachs Data Production

Note: Average Marginal Effect of Gender on Top Manager Quartile Placement refers to the average marginal effect of being female relative to males, for females, on the probability of being placed in the top manager quartile. Only Business Units with both male and female professionals and an estimable average marginal effect are displayed. The regression controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, 360 review score, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. "*" after average marginal effects indicates statistical significance of the marginal effect of gender at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 56

Estimated manager quartiling gap by Business Unit: Investment Management, Vice Presidents

Business Unit	Average Marginal Effect of Gender on Top Manager Quartile Placement	Number of Person-Year Observations
Americas Third Party	0.08% *	1,096
PWM US	-0.02%	597
Fixed Income	-0.03%	472
AIMS	-0.09%	406
Fundamental Equity	0.09%	337
Americas Institutional	0.11%	283
QIS	-0.16% *	211
PWM	-0.06%	199
IMD Strats	-0.15%	151
Fixed Income + LH	0.03%	107
Market Solutions Group	0.14%	90
GSIP	0.01%	88
Global ISG	-0.26%	73
Global Portfolio Solutions	-0.03%	67
Division Management	0.33% *	66
Wealth Advisory Services	0.01%	62
Capital Markets	0.30% *	61
GSAM Credit Alternatives	0.09%	51
Strategic Client Services	0.42%	19
MSG - SP	-0.35% *	14
PWM LatAm	0.13% *	9

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Marginal Effect:	4.6%
Insignificant Negative Marginal Effect:	49.5%
Insignificant Positive Marginal Effect:	22.9%
Significant Positive Marginal Effect:	23.0%

Source: Goldman Sachs Data Production

Note: Average Marginal Effect of Gender on Top Manager Quartile Placement refers to the average marginal effect of being female relative to males, for females, on the probability of being placed in the top manager quartile. Only Business Units with both male and female professionals and an estimable average marginal effect are displayed. The regression controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, 360 review score, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. "*" after average marginal effects indicates statistical significance of the marginal effect of gender at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 57

Estimated manager quartiling gap by Business Unit: Securities, Associates

Business Unit	Average Marginal Effect of Gender on Top Manager Quartile Placement		Number of Person-Year Observations
FICC Americas Sales	-0.01%		491
Prime Brokerage	-0.03%		392
FICC Strats	-0.14%	*	345
NYSE Specialists	-0.12%	*	256
Americas Sales	0.01%		216
EQ Americas Execution Services	0.15%	*	203
Mortgages	0.09%		201
Clearing	0.11%		192
Equities Strategies	-0.01%		175
Credit Trading	-0.07%		160
AmSSG	0.00%		120
Americas Trading	0.00%		105
Prime Services	0.19%		89
Commodities	0.03%		82
Equities Strats	0.29%	*	77
Global Interest Rate Products	0.02%		59
Credit Principal Investing	-0.19%		49
Securities Services	0.05%		46
Commodities ex-GCPI	0.12%		39
GSET/Futures	0.06%		37
GSPS	0.18%		37
EQ Global Sales	0.17%		35
Global Credit Trading	-0.11%		34
Currency Trading	0.03%		32
FICC Franchise Strats	0.12%		27
IRP ex Agency JV	-0.03%		26
QT	0.11%		25
Global EQ Sales/Execution	0.12%		24
EQ Americas Sales	0.10%		22
Reinsurance Group	-0.18%		20
EQ Global Derivatives Trading	0.22%		20
Money Markets	0.07%		16
Global Credit	0.11%		16
EQ Global One Delta Trading	0.19%		16
Core / Divisional Strats	-0.01%		7

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Marginal Effect:	7.4%
Insignificant Negative Marginal Effect:	43.7%
Insignificant Positive Marginal Effect:	43.4%
Significant Positive Marginal Effect:	5.5%

REDACTED VERSION

Source: Goldman Sachs Data Production

Note: Average Marginal Effect of Gender on Top Manager Quartile Placement refers to the average marginal effect of being female relative to males, for females, on the probability of being placed in the top manager quartile. Only Business Units with both male and female professionals and an estimable average marginal effect are displayed. The regression controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, 360 review score, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. "*" after average marginal effects indicates statistical significance of the marginal effect of gender at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 58

Estimated manager quartiling gap by Business Unit: Securities, Vice Presidents

Business Unit	Average Marginal Effect of Gender on Top Manager Quartile Placement	Number of Person-Year Observations
FICC Americas Sales	0.03%	1,248
Prime Brokerage	-0.05%	810
FICC Strats	0.01%	731
Americas Sales	0.05%	565
EQ Americas Execution Services	0.01%	543
Prime Services	-0.02%	469
Equities Strategies	-0.06%	327
Americas Trading	-0.03%	294
Credit Trading	0.05%	281
Mortgages	0.01%	275
Clearing	0.07%	272
Equities Strats	-0.08%	260
NYSE Specialists	0.23% *	193
AmSSG	-0.04%	175
Commodities	0.00%	165
GSET/Futures	0.27% *	136
Americas One Delta Trading	0.05%	122
Global EQ Sales/Execution	0.01%	118
EQ Franchise Strats	-0.19% *	115
EQ Global Sales	0.02%	115
GSSG	0.05%	111
QT	0.40% *	91
Commodities ex-GCPI	0.00%	88
FICC Franchise Strats	-0.16%	86
EM Trading LatAM	-0.04%	78
GSET	0.28%	76
Global Credit Trading	0.08%	69
Equities Strats (ex QT)	-0.04%	67
EQ Americas Sales	-0.11%	66
Credit Principal Investing	-0.01%	64
EQ Global Electronic Execution Services and Exec Strats	0.07%	61
IRP ex Agency JV	-0.20%	57
GSPS	-0.06%	48
EQ Global Derivatives Trading	0.08%	48
EQ Global Execution Services	0.29%	48
Futures	0.26% *	47
Securities Services	0.02%	46
Reinsurance Group	-0.04%	45
Global Credit	-0.01%	34
Mortgages Trading (ex JV)	0.10%	34
Principal Strategic Investments	-0.03%	31
FICC Electronic Trading/Exec Strats	0.26% *	29
Short-Term Interest Rates	0.01%	27
FICC Sales Strats	0.11%	22
Commodities Sales Americas	-0.19%	18
GLP/Risk	-0.14%	9

REDACTED VERSION

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Marginal Effect:	1.0%
Insignificant Negative Marginal Effect:	42.4%
Insignificant Positive Marginal Effect:	54.1%
Significant Positive Marginal Effect:	2.5%

Source: Goldman Sachs Data Production

Note: Average Marginal Effect of Gender on Top Manager Quartile Placement refers to the average marginal effect of being female relative to males, for females, on the probability of being placed in the top manager quartile. Only Business Units with both male and female professionals and an estimable average marginal effect are displayed. The regression controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, production, 360 review score, division, and an indicator variable for each Business Unit. The regression specification also includes an interaction between the female indicator variable and the indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. "*" after average marginal effects indicates statistical significance of the marginal effect of gender at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

15. APPENDIX G – GENDER GAPS IN COMPENSATION BY BUSINESS UNIT

Exhibit 59

Estimated compensation gap by Business Unit: Investment Banking, Junior Bankers

Business Unit	Female-Male Compensation Gap	Number of Person-Year Observations
TMT	1.65%	551
Financial Institutions	1.90%	453
Natural Resources	4.85% *	423
Industrial	-2.88%	370
Leveraged Finance	2.37%	333
Public Sector & Infrastructure	0.25%	302
Healthcare	0.77%	295
Consumer Retail Group	2.23%	288
Equity Capital Markets	2.05%	178
Structured Finance	0.52%	173
Real Estate	0.63%	162
RE Financing	1.16%	138
West Region Advisory	0.74%	126
FG Financial Institutions Grp	6.18%	125
Investment Grade	-3.80%	104
FICC Derivatives	-4.51%	95
Equity Derivatives	-5.63%	71
M&A Group	-5.48%	69
CRE Loan Origination	-3.04%	67
Emerging Markets	0.86%	47
Management	26.05%	43
Corporate Finance Solutions	5.37%	41
Investment Banking Services	-5.45%	33
Financial Sponsors / LBO Grp.	7.23%	27
Leadership	-3.04%	23
IBD Strats	5.59%	12
IBD Management & Strategy	-7.22%	11
Corporate & PSI Derivatives	-46.87%	10
FSIG	1.96%	10
Pensions	-17.36% *	7
Commodity Finance	-9.92%	7
Commodities	51.72% *	4
Clean Tech & Renewables Group	18.60% *	3

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Gender Gap:	0.3%
Insignificant Negative Gender Gap:	15.4%
Insignificant Positive Gender Gap:	76.0%
Significant Positive Gender Gap:	8.2%

REDACTED VERSION

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male Compensation Gap are displayed. The Female-Male Compensation Gap is implied by a regression model of compensation. The regression specification incorporates the model for the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, whether a professional was placed in the top manager quartile, and division. The regression specification also includes an interaction between the female indicator variable and an indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male Compensation Gap refers to the percent difference between male and female compensation implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated compensation gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 60

Estimated compensation gap by Business Unit: Investment Banking, Senior Bankers

Business Unit	Female-Male Compensation Gap		Number of Person-Year Observations
Public Sector & Infrastructure	-6.45%		353
TMT	-9.50%		194
Natural Resources	-2.39%		167
Financial Institutions	-8.88%		145
Industrial	14.23%		130
Investment Grade	8.17%		128
Leveraged Finance	8.52%		123
Structured Finance	-11.61%		118
Healthcare	10.22%		112
Consumer Retail Group	16.80%	*	112
RE Financing	-20.64%	*	82
Equity Capital Markets	4.25%		71
FICC Derivatives	-14.91%		67
FG Financial Institutions Grp	-10.44%		66
Real Estate	13.90%		62
M&A Group	-1.00%		44
Equity Derivatives	25.48%		32
Investment Banking Services	51.46%	*	30
Financial Sponsors / LBO Grp.	-44.21%	*	27
Management	34.17%	*	26
Corporate Finance Solutions	-39.19%	*	21
Emerging Markets	-24.05%		13
Corporate & PSI Derivatives	-43.58%	*	8
FSIG	0.32%		8
IBD Strats	-22.63%		6
Commodities	39.71%	*	2

Percent of Female Person-Year Observations in Business Units with:

Significant Negative Gender Gap:	7.3%
Insignificant Negative Gender Gap:	51.1%
Insignificant Positive Gender Gap:	32.8%
Significant Positive Gender Gap:	8.7%

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male Compensation Gap are displayed. The Female-Male Compensation Gap is implied by a regression model of compensation. The regression specification incorporates the model for the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, whether a professional was placed in the top manager quartile, and division. The regression specification also includes an interaction between the female indicator variable and an indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male Compensation Gap refers to the percent difference between male and female compensation implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated compensation gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 61

Estimated compensation gap by Business Unit: Investment Management, Associates

Business Unit	Female-Male Compensation Gap		Number of Person-Year Observations
PWM US	-0.79%		1,002
AIMS	6.58%		310
PWM	0.87%		287
Americas Third Party	-2.74%		260
QIS	-4.36%		141
Fixed Income	17.55%	*	141
IMD Strats	6.65%		118
Americas Institutional	20.85%	*	88
Fundamental Equity	-13.88%		86
Market Solutions Group	10.35%		65
Global Portfolio Solutions	2.85%		55
Global ISG	3.55%		41
GSIP	13.62%		40
Division Management	8.42%		37
Wealth Advisory Services	-0.98%		33
Fixed Income + LH	-28.62%	*	28
GSAM Credit Alternatives	-29.43%	*	19
PWM LatAm	22.00%		16
Capital Markets	-26.95%	*	12
Alternative Capital Markets	-1.12%		10
GSAM Private Real Estate	25.14%	*	10
US ACM	79.69%	*	9
Reinsurance	-6.53%		7
MSG - SP	34.80%	*	7
Quantitative Equity	-46.73%	*	6
PCG	-27.91%	*	4
MSG - GOAS	-4.13%	*	4
US MCG	-49.62%	*	3
REIT	-3.93%		3
Lending	16.33%		3

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Gender Gap:	3.0%
Insignificant Negative Gender Gap:	54.8%
Insignificant Positive Gender Gap:	31.7%
Significant Positive Gender Gap:	10.6%

REDACTED VERSION

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male Compensation Gap are displayed. The Female-Male Compensation Gap is implied by a regression model of compensation. The regression specification incorporates the model for the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, whether a professional was placed in the top manager quartile, and division. The regression specification also includes an interaction between the female indicator variable and an indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male Compensation Gap refers to the percent difference between male and female compensation implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated compensation gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

Exhibit 62
Estimated compensation gap by Business Unit: Investment Management, Vice Presidents

Business Unit	Female-Male Compensation Gap	Number of Person-Year Observations
Americas Third Party	-4.48%	1,482
PWM US	-6.88%	1,143
Fixed Income	-13.29% *	705
AIMS	4.61%	593
Fundamental Equity	-9.89%	474
Americas Institutional	-5.91%	336
IMD Strats	-9.08%	280
QIS	-7.16%	279
Wealth Advisory Services	-5.02%	263
Market Solutions Group	-6.60%	214
PWM	-12.71%	199
Global Portfolio Solutions	0.05%	145
Global ISG	-15.74% *	135
GSIP	-12.09%	114
Division Management	0.13%	108
Fixed Income + LH	-16.06%	107
GSAM Credit Alternatives	-7.40%	104
Capital Markets	0.42%	61
Americas Client Business	-3.65%	52
Insurance	5.49%	50
Money Markets	-24.67%	28
Strategic Client Services	-18.73%	27
Global PWM	-14.94%	18
MSG - Central Muni	-22.30%	16
Alternative Capital Markets	-1.19%	16
REIT	-38.85% *	14
MSG - SP	24.81%	14
US MCG	-13.11%	12
MSG - GOAS	82.76% *	12
Centralized Trading & Risk	-21.90%	11
US ACM	84.70% *	10
PWM LatAm	21.94%	9

REDACTED VERSION

Business Unit	Gap		N
GSAM Private Real Estate	-35.07%		8
Reinsurance	-11.24%		8
PCG	13.65%		8
Communications & Marketing	-59.95%	*	7
Honest Dollar	-3.20%		7
GS Acquisition Strategies	-18.32%		4
Real Estate Investment Group	8.21%	*	4
Lending	-39.20%	*	2

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Gender Gap:	7.4%
Insignificant Negative Gender Gap:	76.4%
Insignificant Positive Gender Gap:	15.7%
Significant Positive Gender Gap:	0.5%

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male Compensation Gap are displayed. The Female-Male Compensation Gap is implied by a regression model of compensation. The regression specification incorporates the model for the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, whether a professional was placed in the top manager quartile, and division. The regression specification also includes an interaction between the female indicator variable and an indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male Compensation Gap refers to the percent difference between male and female compensation implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated compensation gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 63

Estimated compensation gap by Business Unit: Securities, Associates

Business Unit	Female-Male Compensation Gap	Number of Person-Year Observations
FICC Americas Sales	-4.83%	620
Prime Brokerage	7.85%	392
FICC Strats	-12.15% *	345
NYSE Specialists	-3.82%	256
Americas Sales	2.47%	216
EQ Americas Execution Services	-5.59%	203
Mortgages	-12.54%	201
Clearing	-1.39%	192
Equities Strategies	1.44%	175
Credit Trading	-19.22%	160
Prime Services	5.98%	144
EQ Global Sales	-1.54%	121
AmSSG	8.20%	120
GSSG	-20.15%	106
Americas Trading	9.62%	105
Global Credit Trading	-1.04%	96
Commodities	-18.33% *	82
Equities Strats	2.32%	77
FICC Desk Strats	15.00% *	61
Global Interest Rate Products	-16.99%	59
EM Trading LatAM	14.41%	51
EQ Global One Delta Trading	-19.21%	50
Credit Principal Investing	-19.66%	49
Securities Services	8.71%	46
ETF Specialists	-23.47% *	45
Commodities ex-GCPI	-12.29%	39
EQ Global Derivatives Trading	6.56%	39
IRP ex Agency JV	-9.94%	38
EQ Desk Strats	-0.81%	37
GSET/Futures	24.04% *	37
GSPS	26.15%	37
Mortgages Trading (ex JV)	-22.65% *	36
Currency Trading	19.36%	34
Commodities Trading	-5.73%	32
FICC Franchise Strats	15.67%	27
Americas Derivatives Trading	-15.99%	26
EQ Elec Exec Svcs/Strats	1.34%	26
EQ Sales Strats	-14.27%	25
QT	58.84% *	25
Global EQ Sales/Execution	3.85%	24
EQ Global SMM	8.29%	24
IRP Mortgages Agencies JV	9.82%	23
FICC Sales Strats	14.86%	22
EQ Americas Sales	23.55%	22
Special Assets Group	30.39%	22
Reinsurance Group	27.21%	20
GSET	-16.71% *	19
FICC SMM	6.61%	19

REDACTED VERSION

Business Unit	Gap		N
Principal Strategic Investments	-13.22%	*	17
Equities Strats (ex QT)	-12.40%		17
Global Credit	13.73%		16
Money Markets	53.37%	*	16
EQ Franchise Strats	-10.59%		15
EQ High Touch Exec	-2.94%		15
Americas One Delta Trading	54.40%	*	14
EQ Global Exec Svcs	58.70%	*	13
IBD Strats	1.00%		12
Marquee	-22.90%	*	11
Quantitative Trading	-9.85%		11
Commodities Trading ex-GCPI	38.59%		11
EQ Global Electronic Execution Services and Exec Strats	-17.17%	*	10
EQ Global Execution Services	-2.41%		9
IRP (ex Agency Mortgages & Short Term JV)	1.74%		9
Futures	38.04%	*	9
Principal Investing Desk Strats	5.23%	*	7
Core / Divisional Strats	20.07%		7
Currency Trading (ex. Short Term JV)	-21.22%	*	6
EQ Global Execution Services ex-Electronic	25.14%	*	6
Commodities Sales Americas	-21.47%		5
Global Liquidity Products	-9.01%		4
GLP/Risk	-6.67%		4
EQ Global One Delta SMM / Trdg Strats	16.22%		4
Securities Desk Strats	56.24%		4
FICC Japan Sales	98.01%	*	4
Credit Research	20.60%		3
Securities Business Management	-37.24%	*	2
GS Bank	-20.85%	*	2
Securities Desk Strats/GLP/Risk	162.65%	*	2

Percent of Female Person-Year Observations in Business Units with:

Significant Negative Gender Gap:	8.9%
Insignificant Negative Gender Gap:	48.1%
Insignificant Positive Gender Gap:	40.4%
Significant Positive Gender Gap:	2.6%

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male Compensation Gap are displayed. The Female-Male Compensation Gap is implied by a regression model of compensation. The regression specification incorporates the model for the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, whether a professional was placed in the top manager quartile, and division. The regression specification also includes an interaction between the female indicator variable and an indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male Compensation Gap refers to the percent difference between male and female compensation implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated compensation gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

Exhibit 64

Estimated compensation gap by Business Unit: Securities, Vice Presidents

Business Unit	Female-Male Compensation Gap		Number of Person-Year Observations
FICC Americas Sales	5.00%		1,480
Prime Services	0.69%		867
Prime Brokerage	1.24%		810
FICC Strats	-9.79%		731
Americas Sales	-4.10%		565
EQ Americas Execution Services	3.12%		543
Equities Strategies	-18.34%		327
Americas Trading	-5.17%		294
Credit Trading	-40.24%	*	281
Mortgages	-19.83%		275
Clearing	0.90%		272
Equities Strats	-8.44%		260
EQ Global Sales	4.96%		253
GSSG	-12.76%	*	220
NYSE Specialists	27.92%		193
AmSSG	-14.26%		175
Commodities	-30.55%	*	165
Global Credit Trading	-11.05%		161
GSET/Futures	15.00%		136
Americas One Delta Trading	12.84%		122
Global Interest Rate Products	17.44%		122
Global EQ Sales/Execution	3.07%		118
EQ Global One Delta Trading	11.65%		116
EQ Franchise Strats	-14.18%		115
EQ Elec Exec Svcs/Strats	-2.74%		105
Currency Trading	99.71%	*	104
EM Trading LatAM	5.08%		101
FICC Desk Strats	-12.63%		98
EQ Desk Strats	-7.57%		98
FICC SMM	-13.86%		95
QT	18.37%		91
Commodities ex-GCPI	2.90%		88
FICC Franchise Strats	-0.81%		86
EQ Global Derivatives Trading	4.78%		76
GSET	13.73%		76
IRP ex Agency JV	15.39%		72
EQ High Touch Exec	18.49%		69
Americas Derivatives Trading	-31.72%	*	67
Equities Strats (ex QT)	-8.92%		67
EQ Americas Sales	14.75%		66
Money Markets	-15.04%		65
Credit Principal Investing	-20.93%		64
QT Strats	-20.20%		63
EQ Global SMM	-28.24%	*	61
EQ Sales Strats	-3.29%		61
EQ Global Electronic Execution Services and Exec Strats	11.63%		61
Mortgages Trading (ex JV)	-18.70%		58

REDACTED VERSION

Business Unit	Gap		Count
FICC Sales Strats	9.71%		50
GSPS	-17.00%		48
Principal Strategic Investments	1.42%		48
EQ Global Execution Services	2.02%		48
Commodities Trading	27.65%	*	48
Futures	32.61%		47
Securities Services	-10.71%		46
Reinsurance Group	-1.73%		45
Special Assets Group	23.41%	*	45
EQ Global Exec Svcs	-6.00%		44
Quantitative Trading	-13.59%		43
Core / Divisional Strats	-35.03%	*	38
Global Credit	-32.19%		34
FICC Electronic Trading/Exec Strats	-24.84%		29
EQ Global Execution Services ex-Electronic	-4.44%		29
IRP Mortgages Agencies JV	-0.53%		28
Short-Term Interest Rates	-10.59%		27
SLG	1.24%		25
EQ Global Exec Svcs Strats	6.28%		25
Commodities Sales Americas	-2.86%		18
EQ Global Emm Trading and Strats	-23.46%		17
NYSE Specialists and Strats	62.13%	*	17
IRP (ex Agency Mortgages & Short Term JV)	-32.23%	*	15
Principal Investing Desk Strats	-26.13%		15
QT/Specialists and Strats	16.45%		15
EQ Global One Delta SMM / Trdg Strats	-34.15%	*	11
GLP/Risk	-10.25%		11
Securities Desk Strats	-33.78%	*	9
Securities Desk Strats/GLP/Risk	-37.76%	*	7
Marquee	-34.46%		7
Securities Business Management	13.99%		7
Cross Divisional Sales	-27.40%	*	6
Credit Research	8.48%		6
Principal Strategic Investment Group	22.30%		3

Percent of Female Person-Year Observations in Business Units with:	
Significant Negative Gender Gap:	4.6%
Insignificant Negative Gender Gap:	33.5%
Insignificant Positive Gender Gap:	61.5%
Significant Positive Gender Gap:	0.4%

REDACTED VERSION

Source: Goldman Sachs Data Production

Note: Only Business Units with both male and female professionals and an estimable Female-Male Compensation Gap are displayed. The Female-Male Compensation Gap is implied by a regression model of compensation. The regression specification incorporates the model for the Baseline compensation regression, which includes controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, whether a professional transferred divisions within a fiscal year, guarantee, function, Business Unit, production, 360 review score, whether a professional received an Outstanding OMR, whether a professional was placed in the top manager quartile, and division. The regression specification also includes an interaction between the female indicator variable and an indicator variable for each Business Unit. The model is pooled across all divisions, but separated by corporate job title. Analysis uses Baseline Regression Sample. Individuals with missing Business Unit are included in the regression, but not displayed. Female-Male Compensation Gap refers to the percent difference between male and female compensation implied by the estimated coefficient on the interaction of the female indicator variable and each Business Unit indicator variable in the specified model. "*" after estimated compensation gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level. Red indicates negative and significant, yellow indicates negative and not significant, light green indicates positive and not significant, and dark green indicates positive and significant.

REDACTED VERSION

16. APPENDIX H – SUMMARY STATISTICS FOR KEY CONTROL VARIABLES

Exhibit 65

Summary statistics for key control variables: 2005–2018

Variables	Female		Male	
	Mean	SD	Mean	SD
Compensation				
1. Per Annum Total Compensation	$382,375	$377,362	$531,742	$644,064
360 Review Score				
2. 2010–2015	8.18	0.44	8.25	0.42
3. Before 2010	4.2	0.32	4.25	0.32
Overall Manager Rating (2016–2018)				
4. Outstanding	0.73	-	0.72	-
5. Good	0.25	-	0.25	-
6. Needs Improvement	0.02	-	0.03	-
Manager Quartile				
7. 1	0.27	-	0.29	-
8. 2/3	0.50	-	0.49	-
9. 4/5	0.23	-	0.22	-
Highest Education				
10. HS or Some College	0.00	-	0.00	-
11. Associate's	0.01	-	0.00	-
12. Bachelor's	0.64	-	0.56	-
13. Master's	0.28	-	0.31	-
14. Professional	0.01	-	0.03	-
15. Doctorate	0.03	-	0.07	-
16. Missing	0.03	-	0.03	-
Experience				
17. Time in Position	3.63	3.38	4.04	3.79
18. Years in IBD	4.3	1.58	4.51	1.6
Lateral Hire				
19. Yes	0.18	-	0.28	-
Covered Employee				
20. Yes	0.42	-	0.50	-
21. No	0.07	-	0.04	-
22. Missing	0.51	-	0.46	-
Guaranteed Pay				
23. Yes	0.01	-	0.01	-
Production				
24. Composite Score: IMD Vice Presidents	34%	24%	46%	26%
25. Daily LTFB Production (thds): IMD Vice Presidents	$664	$831	$1,159	$1,502
26. Daily Gross Production (thds): IBD	$87	$289	$85	$256
27. Daily Production (thds): Securities	$36	$79	$55	$96
28. Daily Gross Production (Rep Projects, thds): IBD Sr. Bankers	$20	$25	$6	$285

Source: Goldman Sachs Data Production

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Note: The sample consists of Associates and Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, non-missing manager quartile, non-missing 360 score / OMR, and who were not self-sustaining Private Wealth Advisors. Production figures represent daily amounts of annualized figures. Years in IBD is defined only for IBD Junior Bankers. Covered Employee is defined only for Securities. I do not include gross production (rep projects) from IBD Vice Presidents who are Junior Bankers.

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17. APPENDIX I – ANALYSIS OF 360 REVIEW SCORES

Exhibit 66
There is no common gender gap in 360 review scores: no controls

Models	Investment Banking		Investment Management		Securities	
	Junior Bankers	Senior Bankers	Associates	Vice Presidents	Associates	Vice Presidents
1. OMR: 2016 to 2018	Prof. Farber Finds No Gender Gap					
2. 360: 2010 to 2015	-0.06*	-0.00	-0.01	-0.01	-0.02	-0.02
3. 360: pre-2010	-0.09*	-0.10*	0.03	0.00	-0.02	-0.05*
Share of Class Members	15%	6%	11%	28%	16%	25%
Number of Class Members	1,257	485	902	2,364	1,350	2,065

Source: Goldman Sachs Data Production

Note: "*" indicates statistical significance at the 5% level. Standard errors are clustered at the individual professional level. The sample consists of Associates and Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, had non-missing manager quartile, had non-missing 360 review score / OMR, and who were not self-sustaining Private Wealth Advisors.
Row 2 displays the female/male difference in 360 review score points received on the 1–9 scoring scale.
Row 3 displays the female/male difference in 360 review score points received on the 1–5 scoring scale. All models begin in 2005 due to limited data.

Exhibit 67
There is no common gender gap in 360 review scores: corrected regression model

Models	Investment Banking		Investment Management		Securities	
	Junior Bankers	Senior Bankers	Associates	Vice Presidents	Associates	Vice Presidents
1. OMR: 2016 to 2018	Prof. Farber Finds No Gender Gap					
2. 360: 2010 to 2015	-0.06*	-0.05	-0.01	-0.03	-0.01	-0.02
3. 360: pre-2010	-0.10*	-0.05	-0.01	-0.01	-0.04*	-0.03*
Share of Class Members	15%	6%	11%	28%	16%	25%
Number of Class Members	1,257	485	902	2,364	1,350	2,065

Source: Goldman Sachs Data Production

Note: "*" indicates statistical significance at the 5% level. Standard errors are clustered at the individual professional level. The sample consists of Associates and Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, had non-missing manager quartile, had non-missing 360 review score / OMR, and who were not self-sustaining Private Wealth Advisors. The model controls for year, location, education, tenure, whether a professional was a lateral hire, whether a professional was a new lateral hire, and production. Appendix C contains detailed descriptions of the production variables. Tenure is time in position, time in position squared, time at GS, and time at GS squared. For Junior Bankers in Investment Banking, tenure also includes years as a Junior Banker.
Row 2 displays the female/male difference in 360 review score points received on the 1–9 scoring scale.
Row 3 displays the female/male difference in 360 review score points received on the 1–5 scoring scale. All models begin in 2005 due to limited data.

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18. APPENDIX J – ANALYSIS OF COMPENSATION

Exhibit 68

Comparison of Farber and Shaw regression models, by division

Controls	Investment Banking 2005–2018		Investment Management 2005–2018		Securities 2005–2018	
	Estimated Compensation Gap	R-Squared	Estimated Compensation Gap	R-Squared	Estimated Compensation Gap	R-Squared
Associates/Junior Bankers						
1. No controls	-3.81% *	0%	-0.27%	0%	-11.72% *	1%
2. Farber Model 2a	-3.25% *	59%	-0.67%	20%	-8.59% *	30%
3. Correct tenure and job controls	-1.91% *	74%	1.21%	59%	-7.73% *	55%
4. Add production controls	-1.89% *	75%			-4.17% *	68%
5. Add controls for 360 review score, OMR, and manager quartile (Baseline)	0.19%	83%	1.57%	67%	-1.32%	77%
Vice Presidents/Senior Bankers						
6. No controls	-13.33% *	2%	-23.62% *	5%	-20.10% *	1%
7. Farber Model 2a	-12.70% *	37%	-18.55% *	27%	-19.89% *	29%
8. Correct tenure and job controls	-10.17% *	49%	-7.88% *	58%	-14.09% *	50%
9. Add production controls	-9.47% *	59%	-5.50% *	64%	-7.20% *	66%
10. Add controls for 360 review score, OMR, and manager quartile (Baseline)	-5.11% *	72%	-5.21% *	71%	-2.74%	78%

Source: Goldman Sachs Data Production

Note: Table shows estimates of gender differences in PATC using alternative models with the specified set of controls. "Estimated Compensation Gap" refers to the percent difference between female and male compensation implied by the estimated coefficient on a female indicator variable (the "female coefficient") in each model specified. "*" after estimated pay gaps indicates statistical significance of the female coefficient at the 5% level. Standard errors are clustered at the individual professional level. The sample consists of Associates and Vice Presidents in the relevant divisions as of the end of the fiscal year who had non-missing PATC, had non-missing manager quartile, had non-missing 360 review score / OMR, and who were not self-sustaining Private Wealth Advisors. Associates/Junior Bankers in Investment Banking, Investment Management, and Securities have 4,626, 2,951, and 4,948 observations respectively. Vice Presidents/Senior Bankers in Investment Banking, Investment Management, and Securities have 2,217, 7,264, and 11,476 observations respectively.

Row 2 includes Farber Model 2a controls: year, location, education, tenure, related prior experience, AA job group, whether a professional was a lateral hire, and whether a professional was a new lateral hire. Tenure is time at GS, and time at GS squared.

Row 3 adjusts tenure and job controls and removes related prior experience. Tenure is time in position, time in position squared, time at GS, and time at GS squared. For Junior Bankers in Investment Banking, tenure includes years in Investment Banking. AA job group has been removed. For all divisions, job controls include Business Unit, an interaction between Business Unit and year, an indicator for guaranteed pay, and whether a professional transferred divisions within a fiscal year. Investment Management job controls also include function. For Securities, job controls include function and an indicator for covered.

Row 4 adds production controls. Investment Banking production controls include quartiles and lagged quartiles of (non-rep) production. From 2005–2011, production (non-rep) is the total revenue from all projects in a given year. From 2012–2018 for Senior Bankers, production (non-rep) is "Accrued [Revenue] Inc Mark." For Investment Banking Senior Bankers, production controls also include quartiles and lagged quartiles of (rep) production and an indicator for whether a professional is in a client representative role. From 2005–2011, production (rep) is the total revenue from projects on which the professional was the client representative. This measure is unavailable from 2012–2018. For Investment Management Vice Presidents, production controls include Investment Composite Score, Investment Composite Score squared, and quartiles and lagged quartiles of gross sales of "Long Term Fee Based" products. Missing and negative Investment Composite Scores are set to zero and total assets under "Long Term Fee Based" products are available from 2011–2018. There are no production controls for Investment Management Associates. Securities production controls include quartiles and lagged quartiles of production. Models that control for production also control for an indicator that is set to one when relevant production variable is missing. All production variables except the Investment Composite Score are annualized.

Row 5 adds controls for 360 review score, whether a professional received an Outstanding OMR, and whether a professional was placed in the top manager quartile. For all divisions, such controls include an interaction between 360 review scores and a review regime indicator for the periods 2005–2009, 2010–2015, and 2016–2018, an indicator for receiving an Outstanding OMR, and an indicator for being placed in the top manager quartile.

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19. APPENDIX K – GROUPS OF CLASS MEMBERS FOR WHOM PROF. FARBER FINDS NO EVIDENCE OF BIAS; CLASS MEMBERS AS DECISION MAKERS IN CHALLENGED PROCESSES

Exhibit 69

Various groups of class members for whom Prof. Farber finds no evidence of bias

	Total Number	Fraction of Class (Associates and VPs)
Associates after 2015		
1. Class members who were only present in the data as Associates after 2015	370	12%
2. Class member observations after 2015	884	8%
VPs after 2015		
3. Class members who were only present in the data as Vice Presidents after 2015	160	5%
4. Class member observations after 2015	1,622	14%
Class members who received Q1 manager quartile, pre-2016		
5. Class member observations with Q1, pre-2016	1,896	17%
6. Class members who ever received a Q1, pre-2016	832	27%
7. Class members who always received a Q1, pre-2016	195	6%
Class members who received Q1 manager quartile		
8. Class member observations with Q1	2,531	22%
9. Class members who ever received a Q1	1,077	35%
10. Class members who always received a Q1	247	8%

	Total Number	Fraction of Class (VPs only)
Promotions		
11. Class member Vice President observations in years when promotions favored women, according to Prof. Farber (2010, 2012, and 2015)	1,343	20%
12. Class member Vice Presidents who were never nominated for promotion in years when they were class-relevant	1,749	86%

Source: Farber Backup Materials; Goldman Sachs Data Production

Note:

Rows 1, 3, 6, 7, 9, and 10 calculate the Fraction of Class by dividing the Total Number by the number of unique class members as defined by Prof. Farber's data build.

Rows 2, 4, 5, and 8 calculate the Fraction of Class by dividing the Total Number by the number of class member-year observations as defined by Prof. Farber's data build.

Row 11 calculates the Fraction of Class by dividing the Total Number by the number of unique Vice President class member-year observations as defined by Prof. Farber's data build.

Row 12 calculates the Fraction of Class by dividing the Total Number by the number of Vice President class members as defined by my data build.

Class members who have at least one missing quartile in the data are excluded from the count of class members who always received a Q1.

339. Note that in the table above, "class member observations" refers to the number of class member person-years.

340. **Class members as decision makers in challenged processes.** About 80 percent of class members ever gave another class member a 360 review. About 74 percent of class members both gave a review to another class member *and* received a review from another class member. In addition, eight percent of class members served as performance managers for other class

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members *and* gave those class members a review in that capacity. See Workpaper 29.

341. Cross ruffing guidelines in the record contain lists of cross ruffers; according to these lists, 49 class members served as cross ruffers in relevant divisions during 2002–2018, accounting for about 8 percent of cross ruffers during that period. See Workpaper 11.

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20. DATA ANNEX

20.1. Corrections to Prof. Farber's "snapshot" date for years prior to 2009

342. When processing PeopleSoft data, Prof. Farber determines a professional's status (e.g., division and corporate job title) for each fiscal year based on the status of the professional on a chosen "snapshot" date. Prof. Farber uses November 30 as the snapshot date for fiscal years prior to 2009 and December 31 as the snapshot date for 2009 onward. In doing so, Prof. Farber fails to account for the fact that Goldman's fiscal years prior to 2009 often end before November 30.[341] For example, fiscal year 2008 ends on November 28 and fiscal year 2006 ends on November 24.[342] This mistake causes him to assign incorrect EMD promotion years for 360 professionals, and to consequently exclude these professionals from the data in those years.

- The following is a specific example where Prof. Farber's arbitrary choice of snapshot date affects promotion year. Based on PeopleSoft data, the VP with Employee ID 7387 first becomes an EMD on November 25, 2006, which is the first day of fiscal year 2007. Therefore, under Prof. Farber's own processing methodology, this professional *should* be coded as promoted through cross-ruffing in fiscal year 2006. Indeed, the MD Selection Data shows that this professional was nominated for EMD promotion and cross-ruffed in fiscal year 2006. However, Prof. Farber's data processing mistake results in this professional being promoted in fiscal year **2005**--one year before she was actually nominated and promoted.

343. To correct his mistakes, I use the ***last day of each fiscal year*** as the snapshot date prior to 2009. By doing so, I correctly identify the years of promotion for 360 professionals which were misidentified by Prof. Farber, and I am able to include them in my analysis of promotions.[343]

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[341] Farber Report, ¶ 43.

[342] See e.g., Goldman Sachs Group, Inc., SEC Form 10-K for period ended November 28, 2008, p. 1; Goldman Sachs Group, Inc., SEC Form 10-K for period ended November 24, 2006, p. 1.

[343] See Workpaper 30.

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20.2. Corrections to specific variables

20.2.1. *Compensation*

344. Prof. Farber's measure of compensation is created using two different definitions, one for years prior to 2012 and one for years from 2012 onward. For years prior to 2012, Prof. Farber uses the variable "Total Cost for Equity Calculated Amount" and then annualizes this measure for observations with part-year employment.[344] For 2012 onward, Prof. Farber uses the variable "PATC USD (FY) (FX - Current)" that reports Per Annum Total Compensation (PATC). As Dr. Ward has previously noted, using the "total cost" annualized for part-year employment "distorts compensation for professionals who were hired during the year and received 'sign-on' or 'make-whole' bonuses."[345] There are, however, existing variables in the CRS data prior to 2012 that store the PATC information (e.g. "PATC USD Adj (FY)").[346] Therefore, my analyses use the PATC variable for compensation information prior to 2012.

20.2.2. *Business Unit*

345. Prof. Farber makes two mistakes when assigning Business Units to IMD professionals. As a result, his Business Unit assignment for IMD professionals deviates from the Cupertino declaration, as follows:

1. According to the Cupertino Declaration, Level 8 in the PeopleSoft data best reflects the organization level at which Business Unit compensation budgets were allocated in 2011 and onward.[347] Prof. Farber incorrectly uses PeopleSoft Level 7 variable for IMD Business Unit beginning in 2011.
2. Prof. Farber also fails to follow the Cupertino Declaration's instruction to include "Value" as a subgroup in the "Fundamental Equity" Business Unit.[348]

346. In addition, I am able to fill in missing Business Unit values for a subset of professionals in IBD who are not assigned to a Business Unit after relying on the variables described in the Cupertino declaration. The logic is as follows. Looking at the IBD data, I find that: (1) for many professionals who do have readily available data about Business Unit, their Business Unit based on the

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[344] Farber Report, ¶ 47.
[345] Expert Report of Michael P. Ward, December 13, 2013, p. 7.
[346] Deposition of Stephanie Blinder, April 30, 2013, pp. 14, 155.
[347] Declaration of Kathleen Cupertino, November 12, 2020, ¶ 7.
[348] Declaration of Kathleen Cupertino, November 12, 2020, ¶ 6.

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Cupertino declaration ("IBD Business Unit") has the same value as their PeopleSoft Level 8 variable; and (2) when an IBD Professional's Business Unit differs from their PeopleSoft Level 8 variable, the mapping between IBD Business Unit and the PeopleSoft Level 8 variable is consistent for certain pairings of IBD Business Unit and PeopleSoft Level 8 each year.

Therefore, if an IBD professional is not assigned to a Business Unit after relying on the variables described in the Cupertino declaration, I assign a Business Unit based on the following two steps:

1. If the professional's PeopleSoft Level 8 value appears among the IBD Business Units in that year for other IBD professionals, I assigned the PeopleSoft Level 8 value as their Business Unit.

2. Next, I create a *one-to-one mapping* between IBD Business Unit and PeopleSoft Level 8 variable for each year (i.e. every IBD professional in one particular IBD Business Unit has the same PeopleSoft Level 8 value, and every IBD professional with that particular PeopleSoft Level 8 value is in the same IBD Business Unit). Then, for professionals who are still missing Business Unit and whose PeopleSoft Level 8 values appear in this one-to-one mapping, I assign the mapped IBD Business Unit for the particular professionals.